

**THE ARCHEOLOGY OF  
MUMMY CAVE, WYOMING:**

**AN INTRODUCTION TO SHOSHONEAN PREHISTORY**



**By  
Wilfred M. Husted and Robert Edgar**

**National Park Service  
Midwest Archeological Center and Southeast Archeological Center  
Special Report No. 4  
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*Available*

Making the report available meets the criteria of 43CFR Part 7, Subpart A, Section 7.18 (a) (1).



## **Dedication**

The Mummy Cave report is dedicated to the memory of my father Wilfred Blew Husted, who passed away in Bridgeton, New Jersey, January 15, 1945, at the age of 45 years, and to my mother Irene Husted Picht nee McAllister, who passed away in Lincoln, Nebraska, August 18, 2000, at the age of 95 years.

Wilfred M. Husted  
Billings, Montana  
June 2001

## Acknowledgments

Robert Edgar participated in the excavation of Mummy Cave from the beginning, acting as field supervisor from 1963 through 1965 and assistant in 1966 when I joined the project as supervisor. Although having no formal training in archeology, Edgar carried out the work in a most creditable manner, and by 1966, had become a very competent excavator. His aid during the final season on the site was invaluable, and his intimate knowledge of the surface archeology of the region added much to our daily discussions on the significance of the materials excavated earlier and being recovered at the time.

Although written in the first person, this report is as much Edgar's as it is mine. His thoughts and ideas have been considered, he provided the descriptions of many of the artifacts, especially those for the bone and wooden objects, and he drew the profiles of the deposits. However, as senior author, errors of commission and omission are mine, and I am solely responsible for the interpretations herein.

The hypotheses to be offered here were developed in great part by Oscar L. Mallory of the River Basin Surveys, Smithsonian Institution and myself before I joined the Mummy Cave Project. The findings at Mummy Cave necessitated some modification of these models and provided evidence for extending them beyond their original limits. Mallory contributed in full measure to the further development of the hypotheses. Hence, he has played a significant role in the production of this report. His criticisms and suggestions offered during our many discussions and his patience with my innumerable interruptions to talk over various matters of interpretation are gratefully acknowledged. Mallory also identified the plant fibers used to make the cordage and basketry.

I wish here to offer my thanks to Warren W. Caldwell, Director of the River Basin Surveys. His contributions are many and varied ranging from constructive criticism to encouragement. Throughout the entire period of my association with the Mummy Cave project he made himself available for assistance, in whatever form was necessary and whenever it was sought. He participated actively with Mallory and me in many discussions of the hypotheses and interpretations. As my supervisor, he was most understanding and encouraging during the all too frequent periods when discouragement and doubt made the completion of this report seem an impossible goal. Mere thanks are a mean reward, but I find myself unable to adequately express my heartfelt gratitude to Warren for his aid and generosity.

It is with fond affection that I acknowledge the kindness and generosity of Robert Edgar and his wife Terry. They offered their friendship and opened their home to me, and I will long remember the many fine meals and pleasant evenings spent with them at their cabin bathed in an aura of the west in another century.

To Robert Pardun and Wayne Winter, crew members during the final season at Mummy Cave, I offer thanks for a job well done. Their enthusiasm and good humor were unbounded making the summer of 1966 one of pleasant memories. Their competence and keen awareness made my job a simple one, and their limitless good humor and lively banter made many a long, hot day more bearable.

A debt of gratitude is owed several members of the staff of the River Basin Surveys, for without their assistance and patience, this report could not have been completed. My sincere thanks go to Edgar W. Dodd, Clarence W. Johnson, and Lee G. Madison who prepared the specimens for study; to Jerry L. Livingston, scientific illustrator, who prepared the figures and lettered the plates; to Wayne L. Nelson, photographer, who photographed the specimens and produced prints for the plates; to Mrs. Willene D. Miller, Miss Linda R. Wilcox, Miss Joyce B. Williams, and especially Mrs. Janice R. Westfall, typists, who struggled valiantly with my hand written drafts and many additions to produce the final product; and to Mrs. Paulette C. Workman for her assistance in making the plates.

Dr. Joseph P. E. Morrison, Assistant Curator, Division of Mollusks, United States National Museum, provided identifications for the shells from the site.

With affection and gratitude I wish to acknowledge the moral support of my wife Beth, a non-archeologist, but a pillar of strength and uncomplaining summer widow. Her sympathetic understanding during the several periods of discouragement with the direction and progress of this report and her ability to soothe and comfort when all seemed for naught are gratefully acknowledged.

W. M. H.

# Contents

Dedication .....	i
Acknowledgments .....	ii
List of Figures .....	iv
List of Tables .....	iv
Foreword     Thomas A. Foor .....	v
Preface       Mummy Cave: Retrospect and Prospect .....	ix
Chapter I:    Introduction .....	1
Chapter II:   The Geology of Mummy Cave .....	7
John H. Moss	
Chapter III:  Pollen Analyses at Mummy Cave and Nearby Areas, Northwestern Wyoming .....	13
H. E. Wright, Jr.	
Chapter IV:   Stratigraphy .....	19
Chapter V:    Radiocarbon Dates .....	23
Chapter VI:   Climatic Considerations .....	29
Chapter VII:  Excavation Techniques .....	31
Chapter VIII: The Evidence .....	35
Chapter IX:   Comparisons .....	95
Chapter X:    Interpretations .....	113
Chapter XI:   The Great Basin and Birch Creek Valley As Seen From Northwestern Wyoming .....	133
Chapter XII:  Western American Archeology and Language: A Hypothesis .....	141
References Cited .....	147
Appendix:    The Mummy Cave Tetrapods .....	163
Arthur H. Harris	
Plates .....	171

## Figures

1. Mummy Cave locality and environs .....	xii
2. North-south profile of the deposits along the East 0 gridline .....	20
3. East-west profile of the deposits along the North 30 gridline .....	21
4. Floor plan of Mummy Cave .....	33

## Tables

1. Climatological data from four collecting stations in the Mummy Cave region .....	3
2. Scientific and common names for modern fauna and flora present in the Mummy Cave region .....	4
3. Radiocarbon dates from Mummy Cave .....	26
4. Rates of deposition and layer ages calculated from uncorrected and corrected radiocarbon dates .....	27
5. Metric data and materials of cordage from Culture Layer 30 .....	69
6. Degree of twist in cordage from Culture Layer 30 .....	69
7. Direction of twist by element .....	89
8. Materials used in the manufacture of cordage .....	89
9. Helix angles of cordage other than one-ply roving .....	89
10. Identified knots .....	90
11. Radiocarbon dates for some Plains sites and components yielding indented base projectile points .....	124
12. Comparison of Shoshone and Bannock culture elements with the Culture Layer 36 assemblage .....	126
I. Mummy Cave tetrapods, with minimum possible numbers of each .....	167
II. Summary of tetrapod distribution by level .....	168
III. Kinds of tetrapods and minimum numbers of each identified by level .....	169

## Foreword

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Few archeological sites provide a look into a broad section of the past, exposing in one awesome stroke, the splendor, the magnificence, and the mystery of cultural successes and failures over long periods of time. This is because, in part, by their nature, most of the things people make, the material expressions of values, thoughts, and beliefs, do not last long. Processes of erosion and degradation work against them. Typically only a few enticing bits and pieces are all that remain, often incomplete, and almost always disappointingly deficient when one considers what might have been preserved. Occasionally, however, the archeologist is provided with a view that exceeds our imagination and dreams. Mummy Cave is one of those rare and wonderful sites — lovingly appreciated, but much of it unknown and hidden from our full view for nearly 40 years. This volume brings to life a wonderful picture of the material culture and history of mountain dwellers during the past 9,000 years.

My charge here is to briefly describe why Mummy Cave is important to archeology—why the publication of this volume is cause for archeologists to celebrate. My principal qualification for this assignment is the simple fact that my period of participation in North American archeology coincides with the 34-year span since the publication of a *Science* article on Mummy Cave (Wedel et al. 1968). I began undergraduate study at The University of Montana in 1969 and immediately developed an interest in North American prehistory. Mummy Cave was considered from the time of publication to be essential reading for students with my interests.

In the years since the original publications (Wedel et al. 1968; McCracken 1978), the need has grown for a more complete account of excavation results. In recent years, most students of Rocky Mountain and adjacent Plains archeology cite the two early Mummy Cave reports to support their interpretations of regional prehistory. Some even have an “underground” photocopy of this volume. Others mention the Mummy Cave point sequences using secondary and tertiary sources. However, it is dismaying to me to see that a number of archeologists trained in the last twenty years, have never seen an original copy of the McCracken report more much less the “underground” photocopy of this volume.

The work that follows is an amazing document. It meticulously records the details of changes in material culture at one of the best-excavated cave sites in the northern middle Rocky Mountains. Susan Hughes (1988:46) noted the importance of these details when she wrote:

The rock shelter provided an unparalleled record of human occupation in the Rocky Mountain region. The 9,000 years projectile point chronology has been used as a standard for point typology throughout northwest Wyoming and western Montana, especially the sequence of early side- and corner-notched points dating between 4500 and 7000 years before the present.

Additionally, it remains amazing for the sheer richness of the artifact assemblages and the high level of preservation of organic materials. Excavators recovered thousands of items. The collection is coherent and provenienced — a rare combination for one of the largest collections of northern middle Rocky Mountain artifacts available for research. The importance of this is that we always feel more comfortable when our theoretical debates rest on a firm base of well-excavated material remains.

Mummy Cave also is a surprisingly valuable site for the kinds of anthropological questions it raises. In 1968, archeologists in western North America were looking for well-excavated sites that illustrated systematic change in artifact form through time (mostly projectile points), and Mummy Cave filled the bill admirably. For example, as Wil Husted relates in this volume’s Preface, he and Oscar Mallory were two archeologists trying to bring order to a rapidly accumulating western North American database (Husted 1968; Mallory 1968). Elsewhere, Husted (1995:38) explains the important role of sites like Mummy Cave in that search for order:



The Western Macrotradition hypothesis (WMT) gradually evolved during Mallory's and my efforts to make sense of data from Hells Canyon, Idaho and Oregon, and rockshelters in Bighorn Canyon, Montana and Wyoming, and Mummy Cave, Wyoming. Oscar was working with the Hells Canyon material, and I was struggling with the Montana and Wyoming information. We both noticed many similarities in our material. Before long, we were working very closely together, conferring constantly on a daily basis, tossing ideas back and forth and getting deeper and deeper into western American prehistory.

Archeologists like Husted and Mallory were working in an intellectual setting that provided great amounts of information, but largely barren in organizing principles and answers to questions of human adaptations and social heritage. Basic point sequences in the region had been worked out in a series of more limited excavations, but the larger picture that contemporary archeologists now work with every day had yet to be worked out. Sites like Mummy Cave provided that larger picture.

As we have seen, Husted's analyses have led him to a series of contributions that have touched on basic issues of the nature and extent of prehistoric human occupation in the Plains. Others have also used the well-defined sequence to further their own ideas about culture history, social identity, and population ecology. For example, others, mostly working on the Great Plains, have tried with varying success, to construct culture histories for their region in part on the basis of observations made on Mummy Cave materials (Frison 1978, 1991; Reeves 1969, 1978; Hofman and Graham 1998:113).

There is another aspect of North American archeology as viewed through Mummy Cave that warrants discussion. Mummy Cave has provided an invaluable source of information for archeologists interested in studying the relationships between the languages and social identities of people producing material culture, and the formal characteristics of the artifacts and features themselves. The title of this volume clearly suggests the importance of Mummy Cave to investigations undertaken by archeologists like Husted, who groups collections of artifacts into larger units that correspond in one way or another to distinctive languages or societies. Husted used an extremely detailed analysis of sites published in 1995 to pose a culture-historical relationship between Shoshonean or Utaztekan ancestors and McKean complex archeological materials (1995:68). Mummy Cave clearly plays a pivotal role in establishing this relationship:

In addition to McKean complexes projectile point styles, Layer 30 of Mummy Cave contained coiled basketry, netting, cordage, grinding stones, worked wood and leather scraps (Husted and Edgar 1968: Pls. 27-31; McCracken 1978: Pls. 47-49; Wedel, Husted and Moss 1968: Fig. 1, 184). This complex of some 4,400 years ago differs little in content from Layer 36, Spring Creek Cave and Daugherty Cave, and is here considered to be ancestral to succeeding assemblages and complexes in Mummy Cave and comparable assemblages on the western Plains identified as Shoshoni or Utaztekan ... Thus, a Shoshonean or at least a Utaztekan cultural continuum on the northwestern Plains and parts of the adjacent Rocky Mountains for the past 5,000 years is hypothesized.

Husted's 1995 article was originally written in 1968. In it he provides a full description of his Western Macrotradition concept. Another version of his proposed relationships is found in Chapters 11 and 12 of this volume and, of course, contributes to the importance of this work.

This volume provides an important record of excavation that focuses on what is in many ways the premier archeological record in the region. Mummy Cave's position of importance has not changed in the past 40 years. I think it is safe to say that this volume also sets the stage for continued, more refined, hunter-gatherer research taking place today as the artifacts and remains continue to yield new insights. Many of the observations and kinds of laboratory techniques we now consider commonplace have been developed since the 1960s. Archeologists like Susan Hughes (1988, 2001) and Richard Hughes (2001) are accordingly taking a fresh look at the collections and are providing new ideas. Wil Husted, of course, continues to explore the wealth of information from Mummy Cave seeking answers to questions that vex archeologists working with regional similarities and differences in comparing the archeological records of the Great Basin, the Great Plains, and the Rocky Mountains.

Now that so much time has gone by since the original excavations, my fondest hope is that we can benefit from a wide range of modern perspectives, and can view the delay as perhaps even useful. We

know more today than we did yesterday, and I hope this volume will present a valuable perspective of our knowledge of the Mummy Cave people's past to the reader of today and the student of tomorrow.

My final argument for the importance of this volume is grounded in my belief that because of well-excavated and well-reported collections like Mummy Cave, we can afford to conserve other archeological sites for future advances in research methods and techniques while building new theory. North American archeologists have learned important lessons from this project — lessons that will be added to and passed on to future generations. Future use of the information contained in this volume will undoubtedly fill in more details of the bare outlines of culture history. Just about all archeologists agree that it is desirable to know more about major shifts in human cultural behavior, and this information must come from detailed analysis of materials from excavated sites like Mummy Cave.

In conclusion, as a scientific document the publication of this volume is extremely important. Its significance lies in the fact that it is the best primary record of Mummy Cave and its large assemblage of excavated artifacts and the excavations date to a time that was a formative period in American archeology. Excavations of this scale are simply not common in the region. The Mummy Cave excavations forcefully shaped both archeological debates and insights into past human life. We still wrestle, albeit with more knowledge, with the meaning of Mummy Cave and the role of the Rocky Mountain ecosystems in the prehistoric West. I enthusiastically look forward to future contributions that undoubtedly will come from making these Mummy Cave data more accessible and applying them to such problem areas as population dynamics and the social interactions of people from the major cultural traditions in western North America.

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## Preface

### MUMMY CAVE: RETROSPECT AND PROSPECT

The Mummy Cave manuscript was completed in 1968, but circumstances prevented its publication until now. A few efforts toward publication were made in recent years, but none came to fruition. It has finally come to pass.

I am deeply grateful to Dr. Mark Lynott, Manager of the Midwest Archeological Center in Lincoln, Nebraska, and Mr. John E. Ehrenhard, Director of the Southeast Archeological Center in Tallahassee, Florida, for making the report available. I also want to express my heartfelt appreciation to Mr. Kenneth P. Cannon, Dr. Ralph J. Hartley, and Mr. Thomas D. Thiessen, archeologists at the Midwest Archeological Center, who rode close herd on the publication effort. Ken and Ralph conceived the idea of the National Park Service publishing the manuscript, and they presented it to Mark, who readily concurred. Tom acted as my informal liaison with the Midwest Archeological Center and was particularly helpful during my proofreading of the retyped manuscript.

Ms. Lori Buettner had the unenviable yet vital task of retyping the manuscript, a good share of the work accomplished while on maternity leave. Working with Lori via email during my proofreading chore was a pleasure. Ms. Carrol A. Moxham, Publications Team Leader, and John M. Andresen, Technical Editor at the Midwest Archeological Center, applied their special skills and transformed a 34-year old manuscript into a handsome publication. Being located nearly 900 highway miles from Lincoln and quite naïve concerning the modern publication process, I anticipated all sorts of problems and snags on my part. I need not have worried. With the miracle of email, the process went smoothly, at least at my end, and I shall be ever grateful to the fine people at the Midwest Archeological Center for their kind and gentle treatment of an author long out of the saddle. Last, but certainly not least, I am deeply grateful to the Buffalo Bill Historical Center in Cody, Wyoming, for permission to publish the Mummy Cave report.

My involvement in the Mummy Cave project began rather benignly with a weekend visit to the site during the summer of 1963. My crew and I were conducting excavations at sites in Bighorn Canyon in southern Montana about 90 airline miles to the east and north. Yellowtail Dam was under construction at the mouth of the canyon near Fort Smith, Montana, and these sites would be inundated when construction was completed and the reservoir filled. At the time, I was employed by the Smithsonian Institution, River Basin Surveys, Lincoln, Nebraska. We got wind of a big dig underway up the North Fork of the Shoshone River west of Cody, Wyoming. The Buffalo Bill Historical Center in Cody had begun a program "... to do some serious archeological work in the high Rocky Mountains of northwestern Wyoming" (McCracken 1978:9). The project was conceived and directed by Harold McCracken, then Director of the Buffalo Bill Historical Center, with Bob Edgar of Cody serving as the Project Archeologist. A description of the project, its inception, its conduct, and some interesting photographs not included in this report are provided by the Project Director (McCracken 1978).

My crew and I drove over to the site one weekend to see what was going on. Bob Edgar, his brother Larry, and one or two other fellows were hard at work carefully excavating the uppermost occupation level. They had previously excavated a five-foot test square to a depth of at least 20 feet with cultural deposits evident to the bottom. This shaft was securely shored in four-foot sections for easy removal as the excavations proceeded and covered with stout lumber. OSHA would have approved. After introductions and a tour of the site, the crew and I pitched in to help Bob and his group. After a while we were able to determine that what Bob thought was a single cultural stratum representing the uppermost occupation level actually were two thin adjacent cultural strata. Several more visits were made that summer, and the following year and Bob and I eventually became quite close friends.

Sometime during the 1964 or 1965 field seasons, Bob encountered difficulties with the stratigraphy, and the decision was made to obtain professional assistance for the remainder of the project. I was asked to direct completion of the excavations and prepare the report of the investigations. An agreement was effected between the Buffalo Bill Historical Center and the Smithsonian Institution for my participation in

the completion of the excavations, analyses of the material and data, and preparation of a final report. Under terms of the agreement Bob was included as junior author of the manuscript in recognition of his participation in and extremely important contributions to the project. Bob Edgar, Wayne Winter, Bob Pardun, who was one of my 1962 Bighorn Canyon crew members, and I began the final season of excavations in June 1966 and finished the job late that September.

Bob and Terry Edgar came to Lincoln a month or so later to spend the winter while Bob assisted me with the analyses and other chores. He proved extremely knowledgeable about the archeology of Wyoming and knew the surface archeology of much of the state like the back of his hand. This knowledge was freely shared and was extremely valuable to Oscar Mallory and I in the development of the Western Macrotradition hypothesis. The three of us had many a lively discussion on various aspects of western archeology. Bob's thinking and many of his ideas are incorporated in the Mummy Cave report. Bob and Terry returned to Cody in the spring and I spent the next year and a half or so consolidating my understanding of western American prehistory, deciding how Mummy Cave fit into the broader picture, and putting it all into the final report that was completed in 1968.

A preliminary summary article on the Mummy Cave investigations was published that same year (Wedel, Husted, and Moss 1968). It included a stratigraphic column associating radiocarbon dates and projectile point forms with particular cultural strata. A few preliminary observations were offered concerning mountain adaptation and differences between mountains and Plains archeology, among others. The statement that, "the findings further emphasize the prospective importance of the mountain areas in western prehistory ..." (Wedel, Husted, and Moss 1968:182) appears to have struck few responsive chords among regional archaeologists in the ensuing 33 years. However, hope springs eternal and I remain confident that the extremely important and significant role of the Rocky Mountains in western American prehistory will be realized by all working in the Rocky Mountain and northwestern Plains area. Hopefully, this publication will help.

As Leroy Robert "Satchel" Paige reportedly said, "Don't look back, something might be gaining on you!" However, I have often looked back at that last season of excavation wishing that I had done some things differently. Maximum recovery was not yet in vogue, although there were some doing this sort of thing. I regret not having utilized this procedure at Mummy Cave. No one to my knowledge had heard of Mazama ash in Wyoming, and we wondered how that thick white layer on top of the early side-notched point levels got there until it was identified by a geologist during an INQUA field tour several years later.

I am not a lithic technologist. The reader will note more than a few preforms and blanks in various stages of manufacture identified as knives. As a culture historian I was interested in projectile point form, not how they were manufactured. In some instances I was too hasty in naming projectile point types without sufficient justification. Specifically, the small corner-notched arrowpoint found in Culture Layer 36 was named the Wapiti Corner-Notched point. These are Rose Spring Corner-Notched points (Heizer and Baumhoff 1961) named after the Rose Spring site in California (Lanning 1963) and should be referred to as such. To prevent any further muddying of the typological waters, I have eliminated all references to the name Wapiti Corner-Notched and replaced it with Rose Spring Corner-Notched. Readers will probably notice other errors and omissions, but there is no use fretting over spilled milk. However, the Mummy Cave collections are ripe for analyses by newer generations of archeologists with better training and, I hope, a broad view of western American archeology.

On the other hand, I offer no excuses or apologies for the interpretation of the Mummy Cave data. I have always been a culture historian. In 1966, William Mulloy's (1958) chronology for the northwestern Plains was not yet ten years old. Not too long before, I had recovered lanceolate and stemmed projectile points from early contexts at sites in Bighorn Canyon. At the time, these were either unknown or known only from surface collections. Excavation of Mummy Cave provided some insights into possible sources for these unknown point types and added new fuel for the typological and interpretive fires. Chronology building, at least for the earlier part of regional prehistory, was still a necessity. Although there were small gaps here and there, the Mummy Cave projectile point sequence integrated with previously obtained data indicated a cultural continuum in the central Rocky Mountains from about 10,000 years ago to historic times.

A replicable sequence of projectile point types changing with time is a hallmark of the Rocky Mountain chronology. Attempts to reconcile this sequence with contemporary explanations were unsuccessful. Jennings' (1957) Desert Culture Hypothesis, with its concept of the early appearance and persistence of projectile point types and other artifacts, simply did not agree with our data. Earl Swanson's (1962) Bitterroot culture came close, but it too incorporated longevity of projectile point types. There had to be something better.

Oscar Mallory, a colleague at the River Basin Surveys, was working on previously excavated materials from Hells Canyon, Idaho. Our artifacts and stratigraphic information bore a goodly amount of similarity and identity and we naturally gravitated toward one another in our efforts to interpret and explain these data. This relationship resulted essentially in a two-man think tank with the blessings of Dr. Warren W. Caldwell, then Chief of the River Basin Surveys. Warren gave us free rein to explore the intricacies of western American archeology for a period of two years. Oscar and I immersed ourselves in the archeological literature of most of the United States west of the Mississippi River including the Great Plains, Rocky Mountains, Columbia Plateau, Great Basin, and the Southwest. We gradually became aware of many similarities and identities, particularly in projectile point types, across great distances and physiographic boundaries from the Missouri River to the Sierra Nevada and from the southern Canadian Rocky Mountains and Plains into northern Mexico.

The upshot of this effort is the Western Macrotradition Hypothesis (Husted 1968, 1969, 1995; Mallory 1968), which is the basis of my interpretation of the Mummy Cave and Bighorn Canyon data. The core of this hypothesis is that the middle and northern Rocky Mountains are the homeland of the Aztec-Tanoan-speaking peoples of the western United States and that the Eastern Shoshone and their ancestors have been in Wyoming for 10,000 years. A number of other ideas, including the ultimate eastern source for the early side-notched projectile point and its wider implications, McKean complex origins, and the differences between Avonlea and Avonlea-like projectile points and their meaning, are presented within the hypothesis and discussed herein.

Over the years, a few individuals have obtained copies of the Mummy Cave manuscript, and it has been cited in a number of publications, usually for its basic data. The interpretations have been largely ignored. Vastly more data have become available in the 35 years since the Mummy Cave excavations ended. However, they only reinforce my understandings of western American prehistory, and I see no reason for any major alterations in my interpretations. Thus, Mummy Cave is presented essentially as written in 1968. For whatever reason, in the manuscript I presented radiocarbon dates as 2000 BC  $\pm$  100 (LAB NO.-000). These have been changed to the more conventional 3950  $\pm$  100 BP (Lab No.-000) format.

Apparently neither was consistency my forte. The original intention was to use the term Culture Layer to describe and discuss the several cultural strata in Mummy Cave. However, the terms Layer, occupation layer, level, cultural level, and permutations of these crept into the manuscript during its preparation. These remain and the reader should treat them interchangeably.

I like to think that my writing has improved during the past 34 years. I have changed a word here and there, and the manuscript has benefited from a thorough editing to eliminate a freshman archeologist's grammatical and syntactical atrocities. However, the report remains essentially as written. Right or wrong, I earnestly hope that this publication will stimulate testing of the hypotheses and interpretations presented in the original Mummy Cave manuscript 34 years ago.

Wilfred M. Husted  
Billings, Montana  
June 2001



# Chapter I: Introduction

## SITE LOCATION AND DESCRIPTION

Mummy Cave (48PA201) is a large rockshelter on the left bank of the North Fork of the Shoshone River in the Absaroka Range approximately 34 airline miles west of Cody, Wyoming (Figure 1). The shelter lies immediately north of the river at an elevation of 6,300 feet. U.S. Highway 14 and 20, one of the two eastern routes into Yellowstone National Park, passes between the site and the North Fork (Plate 1a). Before construction of the highway, the shelter was essentially at the riverbank and was separated from the stream by a gentle slope.

Prior to excavation, the shelter floor lay some 30 feet above the road and about 40 feet above river level. The talus slope dropped steeply from the outer edge of the floor to the shoulder of the highway. A portion of the slope probably was removed during road construction. From the north end of the overhang, the talus increased in height, and a high talus cone lay at the south end. The shelter floor is concave; its lowest point is near the central portion of the overhang.

When excavation began, the shelter was nearly filled. Ultimately, the fill was removed to a level but a few feet above that of the highway. The shelter was well protected throughout its cultural history. During thunderstorms, when winds were gusty and of considerable velocity, rain rarely penetrated the drip line, even at the level of the lower occupation layers. The overhang faces westward and receives the sun's rays near midday. Clear winter afternoons must have been very pleasant, but the interior becomes quite uncomfortable during warm summer afternoons. The excavators found it expedient to begin work early in the morning and quit before the shelter became too warm.

## THE ENVIRONMENT

The Absaroka Range, about 100 miles long and 50 miles wide, lies within the Middle Rocky Mountain Province (Fenneman 1931). Unlike a linear uplift, the Absaroka Range is a dissected volcanic plateau consisting mainly of breccias. It is separated from the Beartooth Range on the north by the canyon of Clark's Fork of the Yellowstone River and terminates at the Owl Creek Range to the southeast. With the Owl Creek and Beartooth Ranges, the Absarokas form the western and southwestern border of the Bighorn Basin. The Yellowstone Plateau, with a general elevation of 7,500 to 8,500 feet, lies immediately west of the Absaroka Range.

Although situated east of the crest of the Absaroka Range, peaks with elevations of 10,000 to 12,000 feet lie north, south, and east of Mummy Cave. Cliffs and steep slopes along the North Fork in the vicinity of Mummy Cave attain elevations of 7,500 to 8,000 feet. Erosion of the volcanic rocks formed vertical cliffs of considerable height including pinnacles, knife-like ridges, windows, and other picturesque erosional forms. In general, the valley bottom is narrow, but park-like open areas up to several acres occur at frequent intervals, especially where lateral streams enter the North Fork. The width of the flood plain varies considerably.

The source of the North Fork is in the high country north of Mummy Cave in the vicinity of Sunlight Peak. From its head, the stream flows westward toward Yellowstone National Park, makes a 180° bend southward and eastward just east of the park boundary, and flows in an easterly direction to its confluence with the South Fork some 7 miles west of Cody. Now dammed at the western end of Shoshone Canyon, the river passes through the canyon and continues northeasterly to enter the Bighorn River approximately 10 miles east of Lovell, Wyoming, at the northern end of the Bighorn Basin (Figure 1).

Climatically, the region is one of cold winters and warm summers. There are no weather-data collecting stations in the vicinity of the site, but stations to the east at the base of the mountains, and others located in the mountains at similar elevations provide general information on climate in the Mummy Cave region. Table 1 presents temperature and precipitation data derived from the annual summaries of climatological data for 1963 and 1964 (U.S. Department of Commerce 1964, 1965). The Cody station is lo-



cated approximately 34 miles to the east at an elevation of 5,000 feet. Buffalo Bill Dam is about 27 miles east at 5,156 feet. Anchor Dam lies some 68 miles southeast at 6,460 feet, and Crandall Creek is approximately 23 miles to the north at an elevation of 6,600 feet.

At Anchor Dam, the terminal spring day with temperatures of 32°F or lower occurs in May, and the first freeze may occur in the latter part of August; however, freezing temperatures during June and July have occurred in the Mummy Cave vicinity. Although summer days along the North Fork are occasionally very warm, nights are cool and pleasant. In 1966, an unusually warm summer according to local residents, many continuous days with temperatures in the high eighties and low nineties were experienced, but by sundown, it had become very comfortable.

The region experiences a maximum precipitation during the months of April, May, and June. Most winter precipitation falls in the form of snow, and thunderstorms are dominant in summer. The passage of fronts occasionally causes periods of cloudiness and rain lasting for a day or two. During September of 1966, snow accumulated on the slopes above Mummy Cave, but rain fell at the elevation of the site.

Mummy Cave lies within the Mountain Biotic Province (Dice 1943) characterized by mountainous terrain, severe winters, and summers of hot days and cool nights. Well-marked life belts largely controlled by altitude, prevailing winds, and slope exposure are a striking feature of the province (Dice 1943:35). The site is situated within the Transition Zone which is confined to the bottom of the North Fork Valley; however, the Canadian Zone reaches low elevations in both the North and South Forks (Cary 1917:41), and some species of plants and animals of both zones are found in the vicinity of the shelter.

The Transition Zone in Wyoming is characterized by sagebrush, yellow pine, and grasses. Douglas spruce and some Rocky Mountain white pines occur in the western mountains (Cary 1917:32–33). Flora of the lower portion of the Canadian Zone includes lodgepole pine, aspen, Douglas spruce, and blue spruce (Cary 1917:39–40). Juniper is common on slopes around the site, and cottonwoods grow in considerable numbers along the river and lateral streams.

Animal life abounds in the Mummy Cave vicinity today, and game resources must have been considerably greater in prehistoric times. Bighorn sheep can be seen grazing on the cliffs and slopes around the shelter until they move to higher country in June. Elk or wapiti have been observed in spring on flats downstream, but these animals also migrate to higher elevations during the summer. Moose move into the valley of the North Fork in summer. The excavation crew was treated to a close view of a cow moose grazing 50 feet from the camp trailer one morning. Deer are commonly seen in the mornings and evenings. Bear frequent the valley and become a nuisance around the camp grounds and tourist lodges. Bison presently inhabit the Yellowstone Plateau to the west.

Smaller mammals observed or known to be present today include the coyote, fox, marten, bobcat, and lynx. Several beavers have dens in the riverbank near the site, and beaver dams can be found on lateral streams. Hare and cottontails are found in the region. Various rodents, chipmunks, and squirrels occur in large numbers.

Fish native to the North Fork include the cutthroat trout, white fish, and sucker. Catfish inhabit the Shoshone River, but whether or not they reached as high as Mummy Cave is not known.

Table 2 lists what are considered the more economically important fauna and flora found in the Transition Zone, and those of the Upper Sonoran and Canadian Zones known to occur in the Intermediate Zone. Data are taken from Cary (1917). Species more common to the Upper Sonoran and Canadian Zones are marked with U and C respectively.

Table 1. Climatological data from four collecting stations in the Mummy Cave region.

<b>Temperature</b>	Year	J	F	M	A	M	J	J	A	S	O	N	D	Annual
Cody	1963	14.2	36.0	37.9	42.5	54.6	61.7	69.2	70.1	63.8	54.8	39.5	23.1	46.8
Cody	1964	27.6	24.0	28.2	43.0	54.0	60.6	72.7	66.5	57.1	50.9	34.0	24.4	45.3
Buffalo Bill Dam	1963	19.2	37.1	38.3	42.5	53.4	—	—	66.5	64.2	57.1	41.8	30.9	—
Buffalo Bill Dam	1964	30.7	29.9	30.5	43.5	53.3	58.1	67.4	63.6	58.1	52.9	36.4	27.0	46.0
Anchor Dam	1963	9.3	31.5	29.3	36.3	49.3	55.7	65.5	64.0	58.8	51.4	34.7	20.2	42.2
Anchor Dam	1964	20.2	19.2	22.6	37.9	48.5	54.8	68.3	62.2	52.5	46.0	31.6	23.9	40.6
Crandall Creek	1963	9.4	26.4	26.1	35.4	46.7	52.3	60.1	59.7	—	48.9	35.3	19.7	—
Crandall Creek	1964	17.4	16.1	20.5	35.5	45.1	50.3	62.1	55.8	48.9	45.1	28.2	19.6	37.1
<b>Precipitation</b>	Year	J	F	M	A	M	J	J	A	S	O	N	D	Annual
Cody	1963	0.21	0.29	0.05	2.12	1.30	2.25	0.60	0.22	1.37	0.11	0.04	0.07	8.63
Cody	1964	0.04	0.09	0.15	1.09	1.85	2.40	0.19	0.04	0.01	1.07	0.33	1.17	8.43
Buffalo Bill Dam	1963	0.88	0.15	0.19	4.33	1.05	2.13	0.54	0.59	1.78	0.10	0.07	0.37	12.18
Buffalo Bill Dam	1964	0.17	0.36	0.32	4.10	1.76	2.38	0.56	0.73	0.90	0.98	0.22	1.00	15.39
Anchor Dam	1963	1.22	0.29	1.05	4.60	1.27	4.16	0.67	1.26	1.50	0.46	0.80	0.60	17.88
Anchor Dam	1964	0.42	0.74	0.69	2.87	1.76	2.15	0.77	0.18	0.10	0.57	0.18	1.32	11.75
Crandall Creek	1963	2.17	1.17	0.21	3.96	2.06	1.54	0.65	0.08	2.31	T	T	1.41	15.56
Crandall Creek	1964	3.32	0.46	0.78	1.60	1.74	1.53	0.45	0.22	0.68	1.34	0.91	2.50	15.53

Note: Temperatures are given in degrees Fahrenheit; precipitation is given in inches; T = trace.

Table 2. Scientific and common names for modern fauna and flora present in the Mummy Cave region.

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<b>Mammals</b>	
<i>Cervus canadensis</i> , C .....	Elk
<i>Odocoileus virginianus macrourus</i> .....	Plains White-Tailed Deer
<i>Odocoileus hemionus hemionus</i> , U, C .....	Mule Deer
<i>Ovis canadensis</i> , U .....	Mountain Sheep
<i>Alces americanus</i> , C .....	Moose
<i>Sciurus hudsonicus dakotensis</i> .....	Black Hills red squirrel
<i>Glaucomys sabrinus canescens</i> .....	Flying Squirrel
<i>Callospermophilus lateralis lateralis</i> , C .....	Say Ground Squirrel
<i>Citellus</i> sp. ....	Ground Squirrels
<i>Castor canadensis</i> , C .....	Beaver
<i>Thomomys</i> sp. ....	Gophers
<i>Erethizon epixanthum</i> , C .....	Yellow-Haired Porcupine
<i>Lepus townsendi campanius</i> .....	White-Tailed Jack Rabbit
<i>Lepus townsendi townsendi</i> .....	Western White-Tailed Jack Rabbit
<i>Sylvilagus nuttalli grangeri</i> .....	Black Hills Cottontail
<i>Felis hipolestes</i> , C .....	Mountain Lion
<i>Lynx vinta</i> .....	Mountain Wildcat
<i>Canis nubilus</i> , U .....	Buffalo Wolf
<i>Canis lestes</i> .....	Mountain Coyote
<i>Taxidea taxus taxus</i> , U .....	Badger
<i>Ursus horribilis</i> .....	Grizzly Bear
<i>Ursus americanus</i> , C .....	Black Bear
	... and several mice, rats, skunks, bats
<b>Birds</b>	
<i>Colymbus nigricollis californicus</i> , U .....	American Eared Grebe
<i>Anas platyrhynchos</i> , U .....	Mallard
<i>Chaulelasmus streperus</i> , U .....	Gadwall
<i>Nettion carolinense</i> .....	Green-Winged Teal
<i>Pedioecetes phasiancellus columbianus</i> .....	Columbian Sharp-Tailed Grouse
<i>Centrocercus urophasianus</i> .....	Sage Hen
<i>Mergus americanus</i> , C .....	Merganser
<i>Branta canadensis</i> , C .....	Canada Goose
<i>Olor buccinator</i> , C .....	Trumpeter Swan
<i>Dendragapus obscurus richardsoni</i> , C .....	Richardson Dusky Goose
	... and numerous perching birds

### Herbaceous Plants

<i>Zygadenus venenosus</i> .....	Poison Camas
<i>Linum lewisii</i> .....	Wild Flax
<i>Opuntia fragilis</i> , U .....	Small-Jointed Cactus
<i>Apocynum andros cemifolium</i> .....	Indian Hemp

### Trees and Shrubs

<i>Pinus scopulorum</i> .....	Yellow Pine
<i>Juniperus scopulorum</i> .....	Rocky Mountain Juniper
<i>Juniperus sabina</i> .....	Creeping Juniper
<i>Populus augustifolia</i> .....	Narrowleaf Cottonwood
<i>Salix</i> sp. ....	Willow
<i>Grossularia inermis</i> .....	Gooseberry
<i>Ribes inebrians</i> .....	Red Currant
<i>Ribes americanum</i> .....	Currant
<i>Cercocarpus ledifolius</i> .....	Mountain Mahogany
<i>Rubus deliciosus</i> .....	Flowering Raspberry
<i>Amelanchier</i> sp. ....	Serviceberry
<i>Prunus melanocarpa</i> .....	Chokecherry
<i>Prunus pennsylvanica</i> .....	Wild Red Cherry
<i>Acer glabrum</i> .....	Mountain Maple
<i>Arctostaphylos ura-ursi</i> .....	Bearberry
<i>Sambucus canadensis</i> .....	Elderberry
<i>Sambucus melanocarpa</i> .....	Mountain Black Elderberry
<i>Symphoricarpos</i> sp. ....	Snowberry
<i>Chrysothamnus</i> sp. ....	Rabbit Brush
<i>Artemisia</i> sp. ....	Sagebrush

### Grasses

<i>Elymus glaucus</i> , C .....	Rye Grass
<i>Stipa nelsoni</i> .....	Feather Grass
<i>Muhlenbergia comata</i> .....	Drop-Seed Grass
<i>Agrostis hiemalis</i> .....	Bent Grass
<i>Poa longipedunculata</i> .....	Long-Stalked Spear Grass
<i>Poa lucida</i> .....	Spear Grass
<i>Panicularia nervata</i> .....	Manna Grass
<i>Festuca ovina duriuscula</i> .....	Fescue Grass
<i>Bromus</i> sp. ....	Brome Grass
<i>Argopyron</i> sp. ....	Wheat Grass

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Notes: Data are taken from Cary (1917). Species more common to the Upper Sonoran and Canadian zones are marked with U and C, respectively.



## Chapter II: The Geology of Mummy Cave

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### INTRODUCTION

Mummy Cave is located at an elevation of 6,300 feet in the Absaroka Mountains of northwestern Wyoming; latitude 44° 27' N; longitude 109° 45' W (Figure 1). It is situated adjacent to U.S. Routes 14 and 20 on the North Fork of the Shoshone River in Shoshone National Forest, 34 airline miles west of Cody, Wyoming, and 12 miles east of Yellowstone National Park. The cave, approximately 150 feet wide and 40 feet deep, is an alcove cut into the bedrock of the valley wall on the outside of a bend of the North Fork River. The roof of the cave now stands approximately 50 feet above river level. A section of the floor exposed in the excavation stands approximately 4 feet above river level. Following formation of the alcove, the river was diverted from the valley wall and a thick accumulation of rock rubble (colluvium), ranging in size from clay-size to angular boulders, gradually filled the cave. At the time of discovery, this fill had completely engulfed and masked the cave. The geologic problems center around: (a) the origin of the alcove; (b) the nature, source, and a rate of accumulation of the colluvium, and (c) a rational explanation for the extreme dryness of the cave, which accounts for the remarkable preservation of the burial for which the cave was named, as well as the perishable cultural materials in two of the layers representing human occupation.

### GEOLOGIC SETTING

The North Fork of the Shoshone River, rising amid the high peaks on the eastern border of Yellowstone National Park, is the main drainage for this part of the Absaroka Range. The North Fork and its tributaries, aided by glaciation near their headwaters and intense weathering and mass wastage on the valley walls, have deeply dissected the volcanic rocks of the area producing a relief of more than 4,000 feet in the vicinity of the site. The North Fork flows eastward to its junction with the South Fork west of Cedar and Rattlesnake Mountains, now the Buffalo Bill Reservoir. From there the combined rivers flow eastward through the narrow, rugged canyon west of Cody into the Big Horn Basin. Since the North Fork Valley is the only access from the Big Horn Basin around Cody to the Yellowstone Plateau, it is not unexpected that Mummy Cave was frequently occupied during prehistoric times. In addition to its fortunate position near the river, it is also the largest cave yet discovered in the area which, together with its dryness, must have made it an unusually commodious and salubrious shelter.

The Absaroka Mountains, in which Mummy Cave is situated, are a dissected eastern extension of the Yellowstone Plateau. They are underlain by early Tertiary volcanic rocks, largely pyroclastics, which were extruded from many small vents or fissures and perhaps a few larger volcanoes (Parsons 1958). Following the terminology of Wentworth and Williams (1932), Hay (1954) classifies similar rocks on the South Fork of the Shoshone as pyroxene andesite tuff-breccias consisting of angular ejecta greater than 32 mm set in a tuff matrix comprising more than 50 percent of the rock. The tuff matrix is fragmental, andesitic, and consists of rock fragments, mineral grains, and material too fine to identify. The Absaroka volcanics are either pyroclastics, i.e., deposited directly by volcanic action, or are waterlaid, or in some cases are mud flows or lahars (Parsons 1958). The North Fork drainage basin is in the area mapped as Early Basic Breccia by Hague (1898). In addition to extrusive rocks, intrusive dikes, 3 to 20 feet thick, cut across the area and commonly stand as walls up to 30 feet high due to their greater resistance to weathering than the extrusive rocks. According to Dorf, at the time the fossil floras found in the Early Basic breccias were formed at Specimen Ridge, the area was near sea level and the climate warm and humid. Subsequently, the area was uplifted to its present elevation. In this uplift, some of the volcanic rocks were deformed.

In the vicinity of Mummy Cave, the tuff-breccia is well indurated, massively bedded, and is crudely stratified. The coarser fragments, which range in size from 1 inch to 4 feet in diameter, are for the most part angular. Rounded particles also are present. The tuffaceous matrix generally comprises more than 50 percent of the rock. Elongate pieces of petrified wood are imbedded in the tuff-breccia bed forming the roof of the cave. Interbedded in the tuff-breccia are massive beds of tuff 6 inches to 3 feet in thickness.

The cliff in which Mummy Cave is cut is composed of massive tuff-breccia and tuff beds tilted 20° to the south. The strata are separable into two units. Forming the upper part of the cliff and extending down to the cave roof are massive, resistant beds of tuff-breccia. Beneath this is a zone in which layers of tuff up to 3 feet thick are interbedded with the beds of tuff-breccia. The cave has developed in this lower zone, and its excavation by erosion and weathering is unquestionably related to the lower resistance of the zone containing the tuff beds.

In general, the rocks in the cave are unjointed except for sheet jointing which has facilitated exfoliation, a process which has contributed to the cave fill. The cliff, however, is cut by two prominent vertical joints which bound the cave on the north and south. They have been widened and deepened by weathering, and constitute channels through which loose rock debris has fallen and washed from the cliff to the cave.

It is not certain whether the dip of the beds in the cliff at the cave is initial, or due to tilting of the strata after their consolidation. The dip is lower than the angle of repose for the gravel in the breccia beds. However, it seems unlikely that the tuff beds could have been laid down with as steep an initial dip. Since faults are present in the area, if not at the cave, it seems likely that the dip of the beds is the result of deformation.

### **ORIGIN OF MUMMY CAVE**

Mummy cave is a re-entrant in a convex cliff of massive volcanic rock located on the outside of a bend of the meandering Shoshone River. Following its formation, this recess was almost completely filled by rock debris (colluvium) from the cave roof and walls and from the cliffs above. Archeological excavation in the fill revealed only part of the total size and shape of the cave. In general form, the alcove consists of an overhanging roof, a curving backwall, and a relatively flat floor in the small area where it was exposed.

The cave is the largest known alcove along the North Fork. The total width parallel to the cliff is believed to be at least 150 feet, about half of which was exhumed in the archeological digging. At its maximum depth from the point of maximum overhang of the rock to the rear wall, the cave is 40 feet deep. Thus, the size of shelter before total filling with rock debris was considerable. The roof, which has an irregular surface due to rocks having fallen from it, dips toward the back wall. The back wall, also rough because of rock dislodgment, is slightly concave outward with its deepest point directly behind the point of maximum roof overhang. An extension of the curving backwall to the south formerly protruded as a bedrock spur to the river's edge. Blasting in the early 1900s removed this spur to provide room for the highway. From the point of junction of the roof and backwall at the Primary Coordinate, the backwall slopes downward and finally outward joining the floor, or one level of the floor, at about the elevation of the highway. The exact shape of the concavity of some sections of the present backwall is not known because of the large size of the rock debris covering part of the slope. In any case, the present rear wall of the cave is not at its original position because of blocks and slabs that fell outward and downward into the fill from the original surface.

On the other hand, where exposed along the Principal Coordinate by power equipment in 1967, the floor was a relatively level surface cut at 6- to 8-foot intervals by channels 2 to 3 feet wide and 1 to 2 feet deep running parallel to the back wall. These large grooves are thought to have been cut by the sediment laden river as it swirled across the bedrock surface when flowing about 5 feet above its present level. Deposits of well-sorted sand were found in some of the channels.

There is some doubt as to whether the surface of this bedrock beneath the colluvium is the true floor of the cave. An exploratory hole dug by Husted and Edgar to the north of the power excavation penetrated below river level without striking bedrock. Possibly their excavation penetrated a pothole common in the floors of turbulent rivers flowing across resistant bedrock. More likely, the bedrock surface beneath the colluvium is irregular, and the floor reached in the power excavation is not the lowest horizontal level in the vicinity.

Mummy Cave was formed by a combination of stream erosion and weathering of the bedrock walls and roof of the cave. That stream erosion played an important part in forming the re-entrant is indicated by three lines of evidence.

First, the cave is located in an area that favors stream erosion, i.e., in a valley wall on the outside of a sharp bend of the swift-flowing North Fork River. Although the river is now diverted from impinging on the cliff, the geometry of the meander indicates that if the cave colluvium and the road were removed, the water would once again flow into the re-entrant and abrade the cliff. Mackin (1937) has vividly described the mechanics by which the Shoshone cuts laterally into valley walls of the Big Horn Basin near Cody.

Secondly, there is evidence on the cave floor that stream erosion took place and that cutting agencies are nearby. The relatively smooth, fluted floor with channels oriented parallel to the cliff face and containing well-sorted sand are best explained by stream abrasion at the base of the cliff. Additionally, the two river terraces 100 yards downstream from the cave contain resistant boulders and cobbles up to 24 inches in diameter. These attest to strong carrying power by the river in the past and indicate that ideal cutting agencies for scouring the cliff were operative. The height of these two terraces above present river level is such that the cobbles and boulders carried downstream would have struck the cliff at the level of the Mummy Cave alcove. It is not surprising that there are no boulders beneath the cave colluvium. The cave is located on the outside of a bend where the current would have been swift, and deposition hardly expectable. By contrast, the terraces downstream where deposition has taken place are on the inside of a bend where the current would be slower.

A third line of evidence supporting the hypothesis of stream abrasion as a major factor in forming Mummy Cave is the presence of a strikingly similar alcove being formed under identical conditions at the present river level near the mouth of Clocktower Creek, a tributary flowing into the Shoshone from the south. At the junction, Clocktower Creek has built a large alluvial fan into the main valley pushing the North Fork against the cliff on the opposite side. Where the North Fork strikes the valley wall on the outside of the bend it has cut an alcove approximately 50 feet wide into the volcanic rocks. The roof is convex; its apex was 20 feet above the summer water level in August, 1966. Soundings inside the cave revealed that the maximum depth to the backwall was 12 feet, and that the floor level ranged from 10 to 15 feet below water level which would thus make the maximum height of the cave 35 feet. The current was swift inside the cave and, as a result, no gravel was deposited on the cave floor. (It will be recalled that this parallels the situation at Mummy Cave.) Downstream from this comparative alcove, however, the channel widens, velocity decreases, and gravel has been deposited on the valley floor. Smaller but similar recesses in the valley walls at present stream level occur at several other localities where the river is abrading bedrock cliffs and spurs. In summary, Mummy Cave was hollowed out in part by the erosive action of the North Fork as it cut downward through the volcanic rocks of the area.

In addition to stream abrasion, Mummy Cave was enlarged by exfoliation of two types: (1) granulation, or loosening and dislodgment, of individual mineral grains, or small aggregates of grains, and (2) physical exfoliation, the splitting off of larger rock sheets of various sizes and thicknesses, due largely to release of confining pressure. Exfoliation has been particularly active on the backwall where partly detached slabs leaning outward from the wall were uncovered during the archeological digging. It is difficult to estimate the amount of cave enlargement attributable to this cause since the ratio of rock debris in the fill derived inside and outside of the cave is not known. However, from the activity of the process during the period of archeological work, and from the number of rock slabs uncovered in the fill, the roof and backwall must have retreated at least 5 to 10 feet.



Dislodgment of individual mineral grains or small aggregates from the cave roof was a daily event visible during the archeological excavation. Because the roof could not be readily examined, it was difficult to determine whether this was due to chemical or physical processes. The roof rock is of low permeability, and the cave bears evidence of having been fairly dry during the period of fill — characteristics that mitigate against chemical weathering. However, the volcanic rocks contain feldspar, hornblende, and pyroxene, which decompose readily. Furthermore, present-day chemical activity was indicated by salt efflorescence formed on many fresh rock surfaces. Dislodgment of the individual grains may therefore have been due to decomposition along contacts between minerals, by stresses set up by an increase in bulk due to chemical weathering, or by stresses resulting from the release of confining pressure described below.

In addition to the “rain” of individual grains, exfoliation of rock slabs from the bedrock backwall has been particularly active throughout the period of fill accumulation as indicated by the number and distribution of platy rock fragments in the fill. In the bedrock of the backwall, massive beds of tuff are interbedded with breccia layers. Many of the exfoliated fragments are derived from the tuff, although some were split from the breccia. Splitting takes place along discontinuous joints 0.5 to 12 inches apart, which run parallel to the wall surface and become more widely spaced inward from the face. These joints cut across bedding and other structures in the rock layers. Physical exfoliation is believed to be the dominant cause of dislodgment. Development of the joints and spalling of the platy rock are due to rock expansion resulting from release of confining pressure as erosion proceeds. This was well demonstrated when exfoliation was reactivated as the archeological excavation removed the pressure of the fill on the backwall — and with dangerous results. Platy slabs, some weighing several hundred pounds, began falling off the backwall causing injury to two men in the work crew. Professional quarrymen were brought in to remove all possible incipient exfoliation sheets; the work then proceeded with more safety.

Although exfoliation is usually thought associated with crystalline rocks, and most commonly with granite, Bradley (1963) describes its development in the massive sandstones of the Colorado Plateau. He points out that exfoliation in these rocks is predominantly a physical process related to the release of confining pressure as erosion exposes deeply buried rocks. This mechanism is believed to explain the exfoliation in the massive volcanic rocks of the Mummy Cave area.

In summary, Mummy Cave was formed by a combination of bedrock erosion by the North Fork of the Shoshone River on the outside of a meander bend, and exfoliation of the backwall and roof of the alcove formed by the laterally cutting stream.

### **ORIGIN OF THE CAVE FILL**

Following cutting of the cave by the North Fork, the river was diverted and a long period of deposition of rock rubble began. The cause of the stream diversion is unknown. It may have been diverted by alluviation in the channel causing a bar to form at the cave mouth, or by a landslide into the river from the cliff above the cave, or by some event upstream from the cave which caused the river to shift its course. However, it is obvious from the fines throughout the fill that the river, once diverted, did not again impinge on the growing sediment.

The cave fill, which has been accumulating for at least 10,000 years, is over 40 feet thick. The upper 28 feet were excavated in the archeological investigation and contained 38 distinct layers with evidence of human occupation. Radiocarbon dates derived from charcoal were obtained for about half the layers. They range from 7280 BC for Culture Layer 4 to AD 1610 for Culture Layer 38.

The sediment making up the fill is homogenous in appearance. It was derived from the local volcanic rocks both within and outside the cave. It is very poorly sorted, ranging in size from silt to boulders with a predominance of gravel sizes. The coarser fraction contains many platy fragments (exfoliation spalls) two to four inches in diameter, which are aligned parallel to one another in the pile. Interspersed throughout the fill, particularly near the backwall, are numerous large angular blocks up to 48 inches in diameter. Smaller blocks are scattered throughout the front part of the deposit. The fill is crudely stratified with lay-

ers consisting predominantly of coarse fragments interbedded with layers with a higher percentage of silt. Thickness of the beds is extremely variable.

In general, the beds dip steeply into the cave from the north and south showing that the principal source of debris was outside the cave. Dips achieve their maximum of approximately 20° near the north and south margins of the cave. They flatten to less than 5° beneath the point of greatest overhang, indicating the presence during accumulation of a relatively level surface in the widest part of the cave.

Toward the bottom of the deposit, the fill contains more and larger blocks. At places in the lower levels near the rear wall, it is difficult to tell whether rock surfaces exposed in the fill belong to blocks that have fallen from the wall or are part of the wall itself. In the upper deposits, blocks are more widely dispersed in the fill and are smaller.

From the dip of the beds into the cave from the north and south, it is evident that much of the rock debris composing the fill came from outside the alcove. Study of the adjacent cliffs reveals that the cave was filled by the encroachment of two fan-shaped deposits which spread into the alcove from the north and south, gradually engulfing the alcove. Directly above the cave, the volcanic rocks are unjointed and have not provided a plentiful supply of materials for the cave. Immediately to the north and south, however, there are two prominent joints which have been weathered into channelways leading upward into funnel-shaped basins in more jointed upper reaches of the cliff. Rock fragments loosened by exfoliation and other weathering either fall or are washed via the channelways to the pile of sediments below. The apex of these deposits is at the lower ends of the prominent vertical joints, and the bedding within the fill dips downward from these points.

Once they have reached the pile of sediment below, the fragments move down its slope by gravity or sheet wash by torrential rain. Downhill creep or sliding is abetted in the winter by surface snow. Both processes were observed in action during the period of the archeological work. Downhill movement tends to align the platy fragments in the fill parallel to the surface of the deposit.

Although sheet wash to some degree has moved the material in the fill, downhill movement by gravity had been the principal agent in their deposition. These rubble deposits are therefore classified as "colluvium," which is defined by Howell (1957) as "loose and incoherent deposits usually at the foot of a slope or cliff and brought there chiefly by gravity."

## RATES OF SEDIMENTATION

Fifteen radiocarbon dates from different culture layers at Mummy Cave afford a unique opportunity to study the rates of accumulation of a colluvial deposit in the Rocky Mountains during the last 9,000 years (Chapter V: Radiocarbon Dates). The rates, expressed in feet of accumulation per thousand years, were obtained by dividing the thickness of sediment deposited between dated horizons by the difference in age between the horizons. Although it is possible that some of the sediment in the culture layers was brought into the cave by man, it is assumed in these calculations that this addition was minimal and that the principal accumulation in culture layers resulted from the same mass wastage processes that produced the sediment between the culture layers.

Rates of accumulation show a wide variation although, in general, sedimentation was more rapid near the bottom of the pile, before 6000 BC, than toward the top. The highest rate, however, 16.2 feet per thousand years, occurred near the middle of the column between 3440 and 3305 BC.

Considered in greater detail, the sedimentation rate was generally high until 5680 BC, followed by a decline reaching a minimum between 5190 BC and 3850 BC. After this period of low accumulation, the rate rose again to a maximum between 3305 BC and 2470 BC and then declined to a low between 2470 BC and 1870 BC. Low rates continued to the present with a minor increase between 870 BC and 100 BC.

Since the production of debris is in part due to climatically controlled weathering processes, it is interesting to compare this record with other late Pinedale and post-Pinedale climatic records. The Pinedale

glacial episode is thought to have continued to approximately 5500 BC followed by the Altithermal, a time of greater warmth and aridity, from 5500 BC to 2500 BC. The Neoglaciation, a period of renewed minor glaciation, has occupied the time from 2500 BC to the present (Porter 1967). If this increase in the rate of weathering and debris production is related to colder, wetter glacial conditions, the Mummy Cave record does not coincide well in detail with the generally accepted climatic sequence. Although the rate is high as expected in late Pinedale time it is also high between 3500 BC and 3300 BC which is in the middle of the Altithermal. Also, the rate does not increase significantly during the Neoglaciation, particularly between 2400 BC and 1000 BC, which is believed to be the time of the Temple Lake advance.

The variable rates of accumulation apparently reflect factors other than climate alone. Exfoliation may be, in part, controlled by climate, but it is fundamentally a stress phenomenon that can produce sediments under any climatic condition. Observation of sedimentation during the last three summers also revealed that chance plays a part in the amount of sedimentation on any one part of the colluvial pile. Sedimentation seems to follow no set pattern; it may build up one area rapidly while contributing little to another. Finally, as the pile becomes larger, the rate of accumulation at any one point tends to decrease unless the supply increases greatly. This is because the same quantity of new sediment has to be spread over a larger and larger surface area. It is my tentative conclusion, therefore, that so many factors govern the rate of sedimentation on colluvial piles or talus cones that it is dangerous to use these rates as climatic indicators.

### **DRYNESS OF THE CAVE**

Mummy Cave, a significant archeological site that contained many culture layers, is also remarkable for its preservation of perishable cultural objects and the mummy from which the cave derives its name. The cave's dryness is principally the result of three characteristics of the rocks above the cave. First, the overlying rocks have extremely low permeability. At present, during times of melting snow or long-continued rain, no water drips from the roof into the cave. Second, the overlying rock is massive and does not have vertical joints. Thus, cracks encouraging downward percolating water are missing. Where vertical joints are present immediately north and south of the cave, the joints have become channelways, and water moves downward along them after rain. Third, the catchment area for precipitation above the cave is very small. The cave is located in a knife-edge ridge between the North Fork on the west and Franklin Creek on the east. There is no flat summit area on which snow or other precipitation can gather and slowly percolate into the rock.

### **SUMMARY**

Mummy Cave is an alcove cut in bedrock on the outside of a bend of the North Fork of the Shoshone River. It was formed largely by river abrasion cutting downward through the volcanic rocks of the region. Radiocarbon dates in deposits laid down subsequent to the cutting indicate that this excavation must have occurred more than 9,000 years ago, and that the river had reached its present level by that time. A similar, present-day example of this process of cave formation can be seen at the junction of Clocktower Creek where the North Fork is undermining and cutting a re-entrant in a cliff of similar volcanic rocks.

Following formation of the cave, the river was diverted which was followed by deposition of colluvial deposits derived from the cliffs above the cave and from the cave roof and rear wall. This accumulation of rock rubble has continued for over 9,000 years to the present time. Man occupied the cave intermittently during this interval as indicated by 38 distinct culture layers separated by sterile deposits.

Granulation and exfoliation of bedrock were important processes in producing the sediments comprising the colluvium. The rate of sedimentation varies greatly, but is generally faster near the bottom of the pile and much slower near the top. Whether this is governed by minor climatic shifts or by the characteristics of a growing colluvial pile is not clear. The remarkable dryness of the cave is due to the absence of joints and low permeability of the overlying bedrock, and to the small precipitation catchment area afforded by the knife-like summit of the ridge in which the cave is located.

## Chapter III: Pollen Analyses at Mummy Cave and Nearby Areas, Northwestern Wyoming

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The sediments of Mummy Cave, on the North Fork of the Shoshone River in the Absaroka Mountains west of Cody, Wyoming, are uncommonly rich in organic remains and have provided abundant material for radiocarbon dating and for archeological interpretation. The preservation of the organic material results from the unusual geologic setting of the site, which is at the base of a nearly vertical, south-facing cliff of massive sedimentary volcanic breccia. The cliff is part of a small triangular ridge at the sharp angle of entrance of a tributary to the Shoshone River, at an elevation of about 6,300 feet. The crest of the ridge is narrow and slopes away from the cliff. The catchment area for rainfall is therefore small. This condition, along with the massive, impermeable character of the volcanic rock, means that very little water enters the rock, and thus very little seeps into the rockshelter debris at the base of the cliff. The surface of the debris slopes from the base of the cliff down to the valley, and what rain that does fall on the surface runs off rapidly. Immediately west of the cliff is a steep, alluvial cone formed by occasional runoff down the slope, and much of the rock debris is washed into the rockshelter in this way.

The rockshelter debris also includes fragments spalled from the roof and cliff of the shelter, probably as a result of frost action. The fine-grained matrix of the debris consists of archeological debris — bone fragments, artifacts, stone chips, charcoal, and well-preserved seeds and wood fragments — as well as sand and silt carried or tracked in by the people, or blown in by the wind. The resulting deposit is a crudely stratified sequence of rubble that contains the records of several thousand years of habitation.

Although most of the original organic matter of the debris has been lost through oxidization, much has remained because of the dry condition of the site. Preservation of organic matter requires either persistently wet or persistently dry conditions. It is the oxygen dissolved in water that causes the degradation of the organic matter. An ordinary soil in a semi-humid region will be wetted by oxygen-bearing rain water or slope wash repeatedly during the year, and the organic material will be so decomposed that little is recognizable. In desert regions, organic material can be preserved because of the complete absence of moisture — for example, the Dead Sea Scrolls. On the other hand, the organic sediments of lakes and peat bogs are well preserved because they are permanently saturated with water that precludes air circulation.

Because of its special geomorphic position, Mummy Cave is relatively dry despite the semi-humid climate of the area. Much of the organic matter is well preserved. Among the organic materials found in the rockshelter sediment are pollen grains. Almost all of the pollen grains are blown to the site by the wind, although some may have been attached to plant material carried in by the people living at the site, and some may have been brought by insects or other animals. Some may represent flowers eaten by man or other animals outside the site; if the pollen grains survived digestion, they could be deposited in feces in the cave and thus provide some information about the diets of man or beast (Martin et al. 1961). But in a forested area the pollen production of trees and shrubs is so much greater than that of herbs that practically all of the pollen deposited in Mummy Cave can be attributed to wind transportation from the natural vegetation in the area.

Pollen production and transportation is variable in its effectiveness, however, and the pollen assemblage at a given level in the rockshelter deposits does not necessarily reflect closely the vegetation in the immediate surroundings. Some tree types produce much more pollen than others so are over-represented in the pollen rain. Although most of the pollen in a forested area probably comes from trees within a few miles of the collecting site, some may be blown to the locality from many miles away. In mountain regions much of the pollen may be carried easily from one vegetation belt to the next up or down the mountainside.

Despite the difficulties in a quantitative interpretation of a particular pollen assemblage, the changes in percentages of major pollen types in a stratigraphic sequence usually has real meaning as a reflection of changing regional vegetation, and in archeological deposits they may reflect human disturbance of the vegetation, or use of certain plants.

The purpose of the present investigation was to provide information on the vegetational and thus the climatic history in the area of Mummy Cave for the period during which the site was occupied, the last 8,000 years, so that interpretation of the cultural sequence might be aided by a background of information on the regional paleoecology. For this objective, a pollen study of the sequence of Mummy Cave was undertaken. Despite the unusually good preservation of some plant remains at certain levels in the archeological sediment, the pollen is neither abundant nor well preserved. Generally, more than half the grains were so badly corroded that they could not be identified. Such poor preservation means that the record is a particularly inaccurate representation of the regional vegetation. For this reason, the analyses of the Mummy Cave samples were not carried out in great detail. Instead, efforts were concentrated on lake sites at different elevations near the Shoshone Valley. Pollen preservation in lakes is ordinarily better than in rock-shelter deposits. It was hoped that at such sites the altitudinal shifts in vegetation belts in the mountains, if such occurred during the time in question, might be detected by detailed pollen analysis. In this way the regional picture of climatic change could be elucidated, and correlation with the archeological sequence in Mummy Cave could be made by radiocarbon dating.

### LAKE SITES

Lakes near the North Fork of the Shoshone River are not common. Although the upper part of the valley was occupied by a glacier during the last glacial period, the valley is so steep that glacial lakes either did not form or have not survived postglacial erosion. A cluster of cirque lakes across the drainage divide ten miles to the north are too far away to provide a close control on the sequence at Mummy Cave; also, they are at too high an elevation and are quite inaccessible.

On the Yellowstone Plateau itself, lakes are numerous, as a result of extensive extrusion of lava flows as well as of glaciation. The easternmost lake was selected for study — a small pond surrounded by a sedge mat about two miles east of Yellowstone Lake and only six miles west of Sylvan Pass, which forms the east rim of the plateau in this area. It is here called Cub Creek Pond, after the nearest named stream, which does not, however, flow into the lake. It is located near the southwest corner of the Pelican Cone Quadrangle (topographic map of the U.S. Geological Survey) at an elevation of about 8,200 feet. It was formed after wastage of the last ice cap that covered the plateau.

Although no lakes exist in the Absaroka Mountains east of the Yellowstone Plateau in or near the Shoshone Valley, several occur in the foothills at and below the base of the forest cover. Southwest of Cody about 20 miles, in the Wapiti Quadrangle, lies a group of several dozen small ponds on the northwest flank of Carter Mountain in a hummocky topography that was probably formed by landslides rather than local glaciation. This area has an elevation of about 8,000 feet and is near the base of the forest belt. One of the ponds in the area of Belknap Creek (NE  $\frac{1}{4}$  Sec. 24, T50N, R104W) was cored for study.

Goff Lake is about 10 miles northwest of Cody (Sec. 26, T54N, R103W) in the area of Cretaceous sandstone and shale. The lake is shown in the Cody Quadrangle at an elevation of about 6,550 feet in a sagebrush landscape east of the forested Rattlesnake Mountain. The origin of the lake is uncertain.

### MODERN VEGETATION

The pertinent vegetational formations of the region start with the sagebrush belt at the base of the mountains, where Goff Lake is located. Scattered juniper trees occur in the upper part of this belt. The lower limit of larger conifers is highly variable, and on outlying foothill ridges it is higher than in the interior valleys of the Absaroka Mountains. On Rattlesnake Mountain west of Goff Lake, for example, it lies at about 7,000 feet, and on Carter Mountain near Belknap Pond it is more than 7,600 feet. The first forest

trees, generally scattered in a savanna structure, are Douglas fir (*Pseudotsuga menziesii*) and, especially near Belknap Lake, limber pine (*Pinus flexilis*). Ponderosa pine, which is so common in most of the other ranges of the Rocky Mountains at this elevation, does not occur in northwestern Wyoming. Groves of aspen (*Populus tremuloides*) are common in the valleys.

Within the Absaroka Mountains themselves, the mass effect of the mountains and plateau increases the precipitation so much that the forest belts extend to lower elevations. The belt of Douglas fir, with scattered limber pine, starts at about 6,000 feet in the valley bottoms and 6,500 feet on the open slopes. It includes the Mummy Cave area (6,400 feet), where tree vegetation is dominated by Douglas fir, with limber pine and juniper (*Juniperus scopulorum*) common. Some lodgepole pine (*Pinus contorta*) and Engelmann spruce (*Picea engelmannii*) occur in the canyon bottom, both near the lower limits of their distribution in the mountains. In the little valley in back of the cliff are trees and shrubs of mountain maple (*Acer glabrum*), cottonwood (*Populus deltoides*), cherry (*Prunus* sp.), serviceberry (*Amelanchier*), willow (*Salix* sp.), and gooseberry (*Ribes* sp.), as well as sagebrush (*Artemisia tridentata*).

Generally the Douglas fir belt extends up to at least 8,000 feet on the mountain slopes. At higher elevations limber pine persists, although the related species white-barked pine (*Pinus albicaulus*) replaces it upward. Many slopes are covered with lodgepole pine (*P. contorta*); this spreads particularly after fires, so its modern distribution is marked by sharply bordered even-aged stands. Engelmann spruce (*P. engelmannii*) and alpine fir (*Abies lasiocarpa*) are also common on the higher slopes, and they extend in long fingers down the valley axes as a result of cold-air drainage, even reaching to 6,400 feet on the North Fork of the Shoshone River. Yellowstone Plateau itself has vast stands of lodgepole pine as well as extensive areas of mixed spruce and fir. Cub Creek Pond, near the eastern rim of the plateau, is bordered by ridges covered with such a forest.

## RESULTS

### *Mummy Cave*

Fourteen pollen samples were collected in August 1964 from a cleaned surface on the SE corner of the main excavation; coordinates N15 x W5–W10, at 0.5 feet intervals. A distinctive layer near the base of the main excavation was chosen as an arbitrary datum for the basal sample and was used for measurement of the vertical sampling intervals. This series was also referred to the standard datum for the excavation.

The stratum of Sample 14 was then traced to the west side of the excavation, where it had a different elevation. Sampling on this wall, within coordinates N45 x N50 x E10 x E15, was then extended to the base of the test pit at the same vertical interval, and 30 more samples were taken here.

The samples consisted mostly of unsorted rock and bone fragments in a matrix of sand and silt. They were prepared for analysis in the following way. A representative portion of about 100 grams was soaked in distilled water for two hours. Particles larger than sand size were screened out and rinsed. The suspension remaining was concentrated by centrifugation. Hydrofluoric acid was added to break down the siliceous minerals, and the material was heated for 10 minutes in a water bath. The acid treatment was repeated after a water wash. Glacial acetic acid and cold nitric acid were then added in turn, after water washes, to remove the products of fluoride digestion.

Eleven samples were analyzed at various levels from the surface to the base of the test pit as it was exposed in August 1964. Generally 30 to 50 percent of the 300 grains counted were unidentifiable fragments of winged conifer pollen types (pine, spruce, fir), and another 20 to 40 percent were other unidentifiable grains. The identifiable grains were mostly pine. A few samples had relatively high percentages of Douglas fir. Grasses, *Artemisia* (sagebrush), and chenopods occurred in most samples.

Because of the generally poor preservation in most of the samples, it was considered inadvisable to invest substantially more effort in pollen analysis of the samples, at least for paleoecological purposes.

Other studies in the western United States have shown that the changes in pollen percentages during the last 8,000 years are slight even in sites with good preservation. It was considered unwise to attempt a detailed interpretation of a site where at least half the pollen grains were unidentified to genus, and an untold number had already been destroyed.

### ***Cub Creek Pond***

An exploratory core taken from the edge of the sedge mat on the east side of Cub Creek Pond in August 1965 showed pollen in good concentration and preservation, so a two-inch-diameter core was taken by R. G. Baker in September 1966. The sediment stratigraphy is as follows:

0–40 cm	coarse peat
40–140 cm	brown medium- to fine-grained peat
140–200 cm	not recovered
200–580 cm	brown fine-grained organic ooze with some plant fragments; layer of white volcanic ash at 475 to 477 cm, probably Mt. Mazama ash fall, about 6,600 years ago
580–725 cm	greenish-brown fine-grained organic ooze, weakly laminated below 680 cm
725–755 cm	light gray weakly laminated silty clay
755–765 cm	dark green organic ooze

Because of the highly organic nature of the sediments, standard methods of preparation for pollen analysis could be used (Faegri and Iversen 1964). Preservation and abundance of pollen was good.

The pollen diagram can be divided into two zones. Pollen Zone 1 extends from the base of the core up to 630 cm. It is marked by relatively low pollen values (20 to 50 percent) of pine and Douglas fir and relatively high values of spruce as well as herbs and shrubs, including especially *Artemisia*, juniper, birch, willow, grasses, and sedges. This pollen assemblage suggests that the site was located in alpine vegetation just above the forest line, or in a park-like landscape, because the modern pollen rain in forested regions of the Rocky Mountains nowhere has such high percentages of non-arboreal pollen (Maher 1963). The pollen assemblage of Zone 1 resembles that of the modern pollen rain in the alpine zone of the San Juan Mountains of southwestern Colorado, for example, where the forest vegetation below the alpine zone is essentially the same as that in northwestern Wyoming except that ponderosa pine occurs below the Douglas fir belt, and lodgepole pine is not present (Maher 1963). The high values of *Artemisia* may be attributed largely to alpine herbs of this genus; likewise the grass and sedge types may be local. The birch and willow may be dwarf forms, and the juniper of the treeline area. Where big pollen producers, such as pine, are absent from the vegetation, the local herbs and shrubs have a chance to be well represented in the pollen rain. The pine and spruce pollen was probably blown to the site from lower elevations east of the plateau, as was the spruce pollen.

The forest line in northwestern Wyoming at present is at about 9,500 feet, although it is highly variable, depending on steepness and orientation of slope and on avalanching and related processes. The local snowline is at about 10,000 feet. During the time of the last (Pinedale) glaciation, snowline was lowered about 1,700 feet (Richmond 1965), and it is reasonable to expect that the forest line was lowered a comparable amount. If so, the Cub Creek site, which has an elevation of 8,200 feet, must have been a few hundred feet above the forest line.

Pollen Zone 2 at the Cub Creek site, which extends from 630 cm to the surface, is characterized by about 80 percent pine pollen; the percentages of other pollen types are generally very low. The pine pollen type involved is *P. contorta*, according to morphological criteria worked out by Hansen and Cushing (1967). Zone 2 may be subdivided tentatively into two subzones at a depth of 240 cm. Zone 2-a below has slightly higher percentages of pine, Douglas fir, and *Artemisia*, and Zone 2-b has more spruce, willow, and sedges. Some of the differences may reflect growth of the sedge mat into the lake, but most of them

probably represent a basic change in the character of the upland vegetation. This change, with increasing percentages of spruce compared to pine, may mean a slight shift toward a cooler climate, for spruce favors the higher, cooler elevations of the mountains compared to lodgepole pine. The smaller percentages of Douglas fir mean the same, for this tree dominates the lower forest and may have been even farther from the site than today. Similar interpretation may be given to the smaller percentages of *Artemisia* pollen: it must have been blown from the sagebrush plains below, for alpine areas probably have been too small in the plateau area in post-Pleistocene time to provide much coverage of herbaceous *Artemisia* species.

Despite the suggestion of a bipartition of Pollen Zone 2 for Cub Creek Pond, it is impossible to quantify the vegetational change that may be represented. Other sites more suitably located on a sharper vegetational boundary may reveal the changes more successfully.

### ***Belknap Pond***

The pollen-bearing sediment at Belknap Pond is extended to a depth of only 250 cm. The general level of pine pollen is much lower (20 to 45 percent) than in Zone 2 at Cub Creek Pond, and *Artemisia* higher (10 to 20 percent). In these respects the Belknap diagram resembles Zone 1 at Cub Creek Pond, but it has more *Sarcobatus* and other chenopods — plants that are common in the basin steppe east of the mountains — and it therefore represents the vegetation at the lower treeline rather than the upper treeline, and the high *Artemisia* percentages reflect the sagebrush of the foothills. The oak pollen must have been blown from far to the south, because *Quercus* does not occur in Wyoming.

The abrupt rise of sedge pollen to 50 percent near the top of the diagram implies a local development of sedges around the lake. If the sedge pollen is excluded from the pollen sum, then the pine curve is seen to be higher in the upper part of the core than below. A slight lowering of the forest into the sagebrush belt might explain the change. No increase in Douglas fir, which is the associate of limber pine in this area, is noticeable at the same level.

### ***Goff Lake***

A core extending to 425 cm below the water surface was recovered at Goff Lake, where the water was about 100 cm deep. Pollen analyzed could be made to a depth of 330 cm. The assemblage reflects the location of the site in the sagebrush hills, with 40 to 60 percent pine pollen blown from the mountains, along with a surprisingly high percentage of spruce. The stratigraphic changes in the curves are not sufficiently diagnostic to indicate important elevation shifts in vegetational belts.

## **DISCUSSION**

Of the four sites examined, only Cub Creek Pond has pollen-bearing sediment old enough to record the Pleistocene vegetation. During that time, the Yellowstone Plateau (8,000 to 9,000 feet) was probably covered with alpine vegetation rather than the lodgepole pine and spruce–fir cover of today. The various forest belts were lower on the mountains, but they were probably not depressed as much as the alpine belt. The depressions may have been great enough to put Mummy Cave in a forest of spruce, fir, and pine instead of the Douglas fir, and the latter may have spread farther onto the hills of the Big Horn Basin east of the mountains. The archeological record at Mummy Cave does not extend back to this epoch, however, nor do the sediment records of the foothill lakes. It is therefore not practical to speculate further on the distribution and extent of the different forest belts for this time interval.

The climatic change that terminated the glacial period in the Rocky Mountains occurred about 11,000 years ago, as represented by a shift in forest composition in southeastern Idaho (Bright 1966), in the Wind River Mountains of Wyoming (Bright 1967), and in the San Juan Mountains of Colorado (Maher 1963). On the Yellowstone Plateau at this time, the vegetation changed from alpine to sub-alpine (with spruce, fir, and pine) and then rapidly to a forest dominantly of lodgepole pine. The transformation was probably complete before 9,000 years ago. By this time the lower forest belts probably reached approximately their present limits, and Mummy Cave must have been in the Douglas fir zone, as today.



Pine forest dominated on the plateau for several thousand years. If the ash layer at 475 cm at Cub Creek Pond is the Mt. Mazama ash (6,600 years old), and if the subsequent sedimentation rate has been constant, then a slight change in forest composition occurred about 3,000 years ago, with an increase in spruce and fir, implying a slightly cooler climate. A possible change in vegetation in the foothills may be inferred from the rise of pine pollen at Belknap Pond, but the time of this possible change has not yet been determined by radiocarbon dating. The Mummy Cave area, which lies in the mountains midway between the Yellowstone Plateau and the foothills, may therefore also have experienced at this time a slight shift in the nature of the forest cover and thereby in climate, leading to conditions that prevail there at the present time.

It should be emphasized, however, that such a shift was relatively minor compared to the changes at the end of the glacial period. A similar conclusion can be reached from the pollen study of postglacial lake sediments in the Colorado Front Range (Pennak 1963). Even in the San Juan Mountains of southwestern Colorado, where a much more detailed study of forest history was undertaken, the sequence shows a relatively minor shift in forest vegetation during postglacial time (Maher 1961).

Before 3,000 years ago, if that is the correct date, the pine and spruce may not have reached to such a low level on the mountain slopes as they do today, and the lower valleys west of Rattlesnake Mountain may have been more open. The Mummy Cave area was in the heart of the conifer forest throughout postglacial time, however, and such archeological changes as can be detected are probably not related to paleoecological changes. The minor climatic shifts of postglacial time probably involved merely movement of forest belts up and down the mountains a few hundred feet, or relatively minor changes in composition, so the basic environment must have remained essentially unaltered.

## Chapter IV: Stratigraphy

The occupation layers of Mummy Cave were separated, for the most part, by sterile strata of sufficient thickness to allow for easy discrimination of cultural levels (Plate 3a). The fill within the shelter consisted of a homogeneous accumulation of colluvium interspersed by 38 occupation zones and 27 thin layers of water deposited silt (Plate 3b; Figures 2 and 3). Roof fall occurred throughout the fill and ranged in size from small, fist-sized rocks to large slabs exceeding five feet in length. Calcite crystals were found throughout the colluvium and in many of the cultural strata.

The colluvium was dark brown and composed of particles ranging from fine sands and silts to large rocks. Many water-worn cobbles and pebbles were present; however, these originated in the volcanic breccia in which the shelter was formed. Large talus cones lay at each end of the shelter. Apparently as these slopes increased in height, material rolled and was washed into the overhang from each end. The upward slope of the strata toward each end was maintained throughout the cultural history of the site, although the shelter was nearly filled before investigations began.

The homogeneity of the non-cultural fill was noteworthy. No non-colluvial strata, such as water-laid gravels or eolian deposits, were present. Nor was there evidence of unconformity. Deposition throughout the cultural history of the shelter was accretional, and the relationship of the occupation levels to the intervening sterile fill indicates that the colluvium accumulated continuously, although probably at varying rates at different times.

A section through the fill from rear to front indicates little accumulation of talus beyond the overhang. The strata are essentially horizontal in an east-west direction (Figure 3). A slight, saucer-like depression was noticeable in the lower occupation levels. Here the silt layers were more numerous and most apparent. It appeared that the silt deposition resulted from ponding of water that entered the shelter via the slopes at each end.

The 38 occupation layers, numbered consecutively beginning with the deepest, varied considerably in thickness and horizontal extent. The excavations were based on a grid of five-foot squares oriented to the cardinal directions. With but one exception, the occupation strata below Culture Layer 24 extended northward to about the N45 gridline. Culture Layer 18 continued for at least another five feet and was still visible in the excavation wall along the N50 line. The major cultural zones from Culture Layer 24 upward extended to at least the N60 line. Layer 36 was readily apparent at the N70 line.

The occupation levels were more consistent in width from the rear wall to the front. Most of the layers extended to a point between the E0 and W10 gridlines. This seemed to be a function of the drip line. The vast majority of material from all culture levels was recovered from the area behind the drip line.

Not unexpectedly, the more ancient cultural strata were the thinnest and least extensive. Appreciable increases in thicknesses occurred with Culture Layer 24 and above, although there were several small, thin lenses in the higher levels. Culture Layers 30 and 36 were thickest and most productive of artifacts.

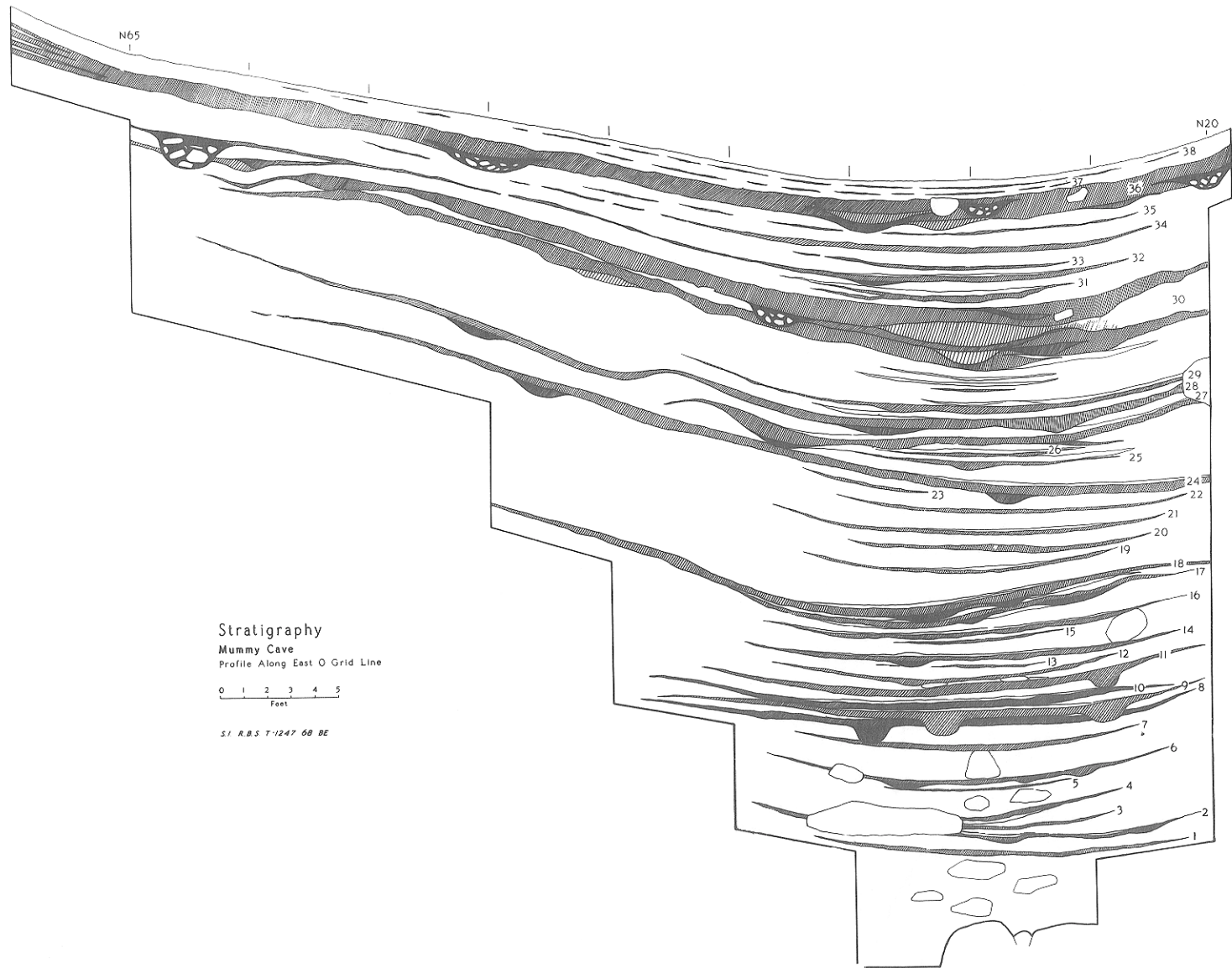
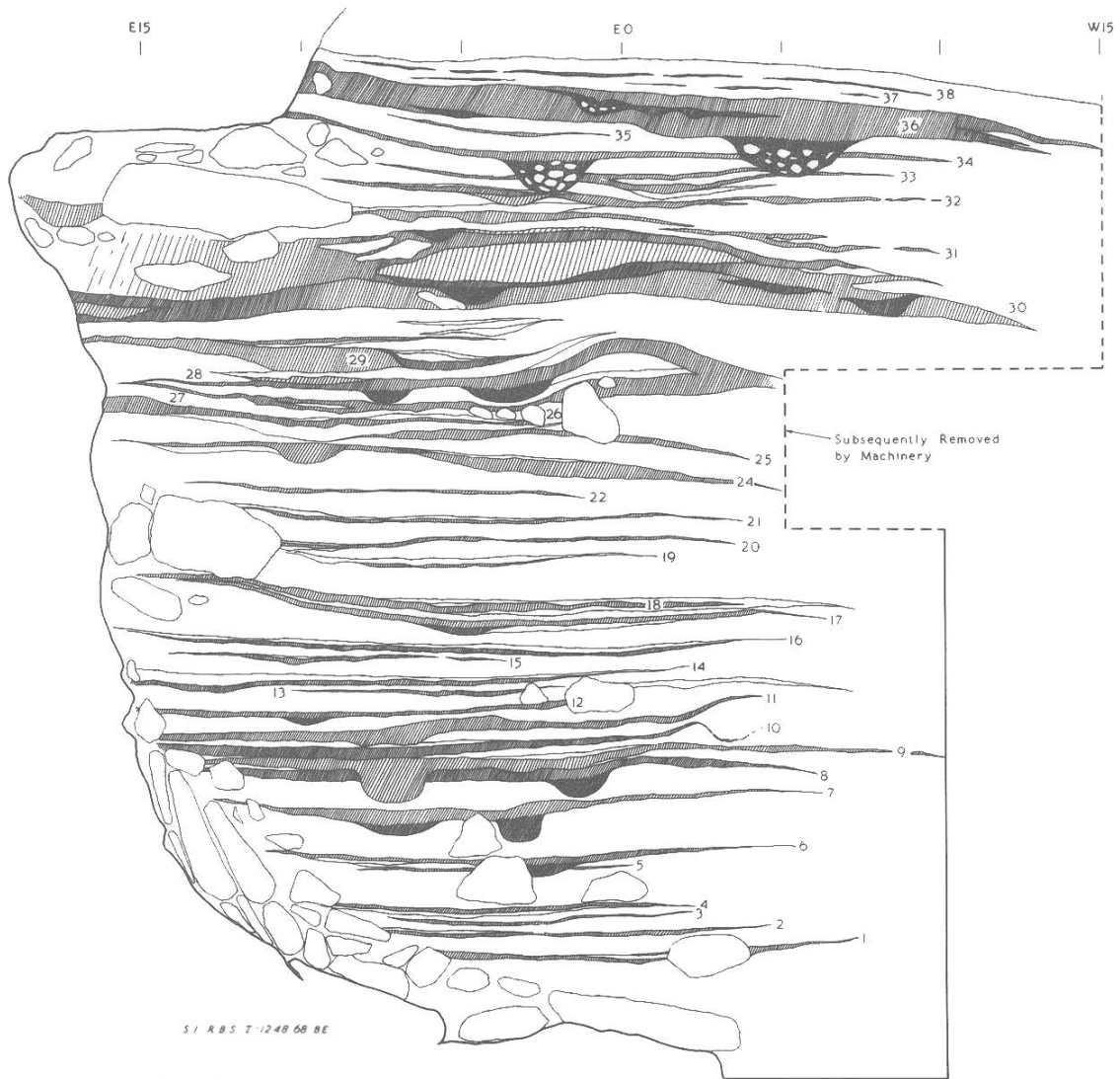


Figure 2. North-south profile of the deposits along the East 0 gridline.



Stratigraphy  
 Mummy Cave  
 Profile Along North 30 Grid Line  
 0 1 2 3 4 5  
 Feet

Figure 3. East-west profile of the deposits along the North 30 gridline.



## Chapter V: Radiocarbon Dates

A series of 26 radiocarbon dates from 18 occupation levels and one date from an unknown provenience were obtained from charcoal in fire pits and from the cultural strata. An exception is the date for Cultural Layer 36, which was obtained from fragments of mountain sheep hide from a robe covering a human burial found in the layer. All samples were processed by Isotopes, Inc., in 1963, 1964, 1965, and 1966. The dates are listed in Table 3.

Prior to 1966, no provenience data other than the cultural level from which the sample was obtained were retained for any of the samples submitted to the laboratory. The samples were merely assigned a numerical designator beginning with the number 1. Assignment of a date to a particular Culture Layer is dependent on Edgar's memory of the details concerning sample collection. Edgar states that all samples were taken from fire pits or concentrations of charcoal in an occupation stratum.

There is no reason to doubt that the dates for Layers 30 to 38 are valid. They are entirely within reason for the manifestations represented in the five dated levels, and both Edgar and I are convinced that the sample proveniences are accurate. Proveniences of four of the five dates from Layers 28 and 24, both containing heretofore undefined assemblages, are questionable. The date of  $5255 \pm 140$  BP (I-1429) is considered to be valid. Mixture between Layers 30 and 28 will be discussed below. Since two of the dates assigned to Layer 28 fall within the range of dates for the manifestation present in Layer 30, the McKean complex, it is entirely possible that they pertain to the higher stratum in view of demonstrated mixture between the two levels. These dates,  $4640 \pm 140$  BP (I-1483) and  $4170 \pm 140$  BP (I-1582), simply cannot apply to Layer 28 and must refer to Layer 30.

Both dates from Culture Layer 24 are considered to be too recent. Again, the date of  $4490 \pm 140$  BP (I-1584) is acceptable for Layer 30; however, Layer 24 was some 5 feet beneath Layer 30, and no mixture was noted. The date is too recent, but the reason for this is undetermined. The older date of  $5390 \pm 140$  BP (I-1466) is reasonable for Layer 28. Mixture between Layers 28 and 24 was not demonstrated, but the date may pertain to a higher stratum. Since it is close to the accepted date for Layer 28, it may well be associated with this stratum.

The three dates from Culture Layers 20 and 21 seem too recent, and the date of  $5100 \pm 260$  BP (I-1586) is obviously too recent in relation to the other two which are in stratigraphic order. The charcoal sample for this date was taken from an occupation level visible in the wall of the deep test pit excavated in 1963, and it is entirely possible that the level was misidentified at the time of sample collection. Only Layer 21 produced a diagnostic artifact, a projectile point of an as-yet undefined type.

The dates of  $7140 \pm 170$  BP (I-1587) and  $6780 \pm 130$  BP (I-2358) from Layers 18 and 17, respectively, may be slightly too recent and appear to be reversed. Vertical separation between Layers 18–16 was minimal. The age of Layer 16,  $7630 \pm 170$  BP (I-1588), is believed to be of the proper order in view of its relationship with the ages of the underlying occupation levels. It seems that little time should have passed between deposition of Layers 17 and 18, at least something less than the 500 years indicated by the dates for Layers 16 and 18; however, an error, if actually present, probably is not too great. These two strata contained projectile points identical to those recovered at the Simonsen and Logan Creek sites.

With the exception of the date of  $8740 \pm 140$  BP (I-2353) for Layer 10, all dates from Layers 14 through 4 seem reasonable. These levels contained lanceolate projectile points found elsewhere at comparable time levels.

The date for Culture Layer 1 is obviously too recent. Contamination by ground water may be responsible.

The date from an unknown provenience,  $6970 \pm 320$  BP (I-1467), is comparable to those for Culture Layers 17 and 18, and might pertain to either. However, because of the lack of demonstrated association, the date has been disregarded.

It will be noted that if the radiocarbon dates from Culture Layers 20 and 21 are accepted at face value, at least eight occupation levels fall within the 5,000- to 6,000-year range, and at most, only two layers could date between 6,000 and 7,000 years. In view of the stratigraphy, this appears most unlikely. As noted above, the dates for Layers 20 and 21 are considered too recent, and this is probably due to the increase in radiocarbon activity in the past (Damon 1965a; Stuiver and Suess 1966). In order to obtain a more realistic estimate of the ages of the cultural zones in the middle portion of the column, level ages were calculated from rates of deposition based on certain radiocarbon determinations. Also it was thought that periods of lesser and greater moisture would be reflected in differential rates of deposition. The lack of non-colluvial deposits, the apparent continuous accumulation of the colluvium in the shelter, and the presence of numerous dated occupation levels indicate that the rate-of-deposition approach has some validity in this instance.

Several assumptions were made in determining the deposition rates. First, it was accepted that deposition would be greater during a cool, moist climate and lesser during periods of warmth and aridity. Consequently, it was assumed that at 8,000 years ago or earlier the climate was cooler and moister than that of today but that it was gradually becoming warmer and drier. The reality of the Altithermal is accepted, and it is assumed that the long drought began at about 7,500 years ago. The environment became increasingly warmer and drier, then gradually returned to a climate approaching that of the present by about 5,000 years ago. Thus, two major climatic periods were accepted — an earlier moist segment and a later drier interval. It was assumed that deposition would be a constant during a particular period. Calculation of a deposition rate for the deposits above Layer 30 is not feasible, however. Apparently, physical factors resulting in a sharp decrease in deposition came into play, and the fact that the shelter was nearly filled with colluvium seems to have been the principal cause.

Since it is assumed that the climate 7,500 years ago was about like the present, the radiocarbon dates of  $7970 \pm 210$  BP for Layer 14 and  $9230 \pm 150$  BP are accepted as valid. The manifestation in Layer 14 has been dated elsewhere, and an age of about 8,000 BP seems reasonable. There was no additional evidence, other than general stratigraphic relationship, to support the validity of the Layer 4 date; however if we accept the Layer 14 and Layer 4 dates, a deposition rate of 186 years per foot of accumulation can be inferred. As a check on the older age, the Layer 8 date of  $8530 \pm 140$  BP was assumed to be correct. The deposition rate calculated from this date, and that for Culture Layer 14 is 192 years per foot, a negligible difference.

Ages based on the 186-year-per-foot rate were calculated for Culture Layers 1–13. Agreement between these ages and the radiocarbon dates for Layers 8 and 12 is very close, the difference being well within the standard deviations of the radiocarbon ages. The calculated age for Layer 1 seems reasonable considering the stratigraphic relationships. If deposition increased gradually over time, the ages would decrease downward; however, any such decrease would appear to be minor.

The segment corresponding to the Altithermal period presents a problem involving the validity of certain radiocarbon dates. The age of  $7630 \pm 170$  BP for Layer 16 appears valid, and that the deposition rate had decreased by this time is indicated by applying the 186-year-per-foot rate to calculate its age. This results in an age of 8020 BP, almost exactly the radiocarbon age of Layer 14. The date of 5680 BC is utilized as one datum in calculating the deposition rate. The other datum is provided by the oldest date for Culture Layer 30, which is  $4420 \pm 150$  BP. This age is well within the range of dates for the manifestation associated with this stratum.

Use of the Culture Layers 16 and 30 radiocarbon dates gives a deposition rate of 292 years per foot. Level ages calculated from this rate are more acceptable than the radiocarbon ages for Culture Layers 21 and 20 and provide at least four ages in the 7,000- to 6,000-year range. This is more consistent with the stratigraphy. The age of Layer 18 is increased by some 250 years, and this too seems more consistent considering its separation from Layer 16. The Layer 28 radiocarbon age is in close agreement with the age based on the rate of deposition, but the Layer 24 date is nearly 550 years younger.

Checks on the 292-year-per-foot rate were made on the assumption that the Layer 20 radiocarbon date is valid. The result is an indicated rate of 523 years per foot. This provided reasonable ages for Layer 17 and 18, but above Layer 21 the dates are obviously too recent. A change in rate from 186 years to 523 years per foot would certainly indicate a climatic change of such proportions that it would be readily apparent in pollen profiles from the region.

It is possible that physical factors could have come into play below Layer 30, thus accounting for the decrease in rate of deposition above Layer 14. There is no way of determining this; however, that an abrupt decrease in the rate occurred between the time of deposition of Layers 30 and 32 is indicated by calculating the rate from the most recent radiocarbon date for Layer 30 and that for Layer 32. The result is a rate of 1,155 years per foot of fill. Applying the Layers 32 and 38 radiocarbon dates results in a rate of 742 years per foot. That the radiocarbon date and calculated age for Layer 28 are in close agreement lends some support to the hypothesis that the reduction in rate of deposition probably is correlated with climate.

The ladder of level ages calculated from the rates of deposition (Table 4) appears internally consistent, and the chronology of the 7500–5000 BP segment appears more realistic than that indicated by the radiocarbon dates for Layers 20, 21, and 24. However, recent investigations have demonstrated that the concentration of natural radiocarbon in the biosphere has not been constant, and therefore, radiocarbon ages and true ages may differ considerably. As long as we confine discussion to the present radiocarbon chronology, it is felt errors in dating resulting from an increase or decrease in radiocarbon activity can be regarded as irrelevant. This assumption will be maintained throughout the remainder of this report, with the exception of the calculated ages for levels between Layers 16 and 30.

On the other hand, that the radiocarbon ages between about 2500 BP and at least 6000 BP appear too recent, seems to have bearing on the assumption that a warmer, drier climate will be reflected in a lower rate of deposition of colluvium at Mummy Cave. Investigation into the problem of radiocarbon variation is continuing; however, results gained so far allow a certain amount of speculation on the consequences of atmospheric radiocarbon variability.

It has been determined that radiocarbon dates of 1000 BP or younger are too recent, and that dates between about 2250 and 1000 BP are generally 50 to 100 years too old (Stuiver and Suess 1966). There seems to be general agreement that a long-term increase in activity began at about 2500 BP, but the duration of the increase is disputed. Damon (1965b) suggested that radiocarbon activity returned to a normal level by about 8000 BP. Stuiver (1967) believes the increase continued to at least 10,000 BP.

Discrepancies between actual ages and radiocarbon ages from 2,500 to about 6,000 years ago are indicated by a comparison of radiocarbon ages and tree-ring data. These data indicate an increase in radiocarbon activity to about 6000 BP. Tree rings that formed about 6,350 years ago indicate decreasing activity beyond 6000 BP (Damon 1965a).

Stuiver and Suess (1966) present a formula for the correction of radiocarbon dates, but caution that it is premature to attempt corrections at the present time. More recently, Stuiver (1967) offered a modified version of the formula, and it appears that some confidence is placed in the equation. The first formula,  $T = 1.4R - 1100$ , where T is the true age and R is the radiocarbon age, was used to correct dates between 2500 and 6000 BP. Stuiver's modification is  $T = 1.4R - 900$ , which increases true ages by 200 years. The latter equation is utilized in correcting dates between 2,500 and 10,000 years ago.

Both equations were applied to certain radiocarbon dates from Mummy Cave. The results are presented in Table 4. The formula  $T = 1.4R - 1000$  was used to correct the radiocarbon date of  $4420 \pm 150$  BP for Culture Layer 30. Assuming that Damon's conclusion that radiocarbon ages of 8000 BP are valid, a new rate of deposition was calculated using the corrected Layer 30 date and the uncorrected radiocarbon date for Layer 16. The resulting deposition rate is 231 years per foot, a reduction of 61 years from the rate calculated from the uncorrected radiocarbon dates. This still indicates a decrease in rate of deposition over that for Layers 1 through 14.



Assuming Stuiver's belief that the increase in radiocarbon activity continued to 10,000 BP is valid, the  $T = 1.4 R - 900$  equation was applied to selected radiocarbon dates from Layers 4 to 30. This decreases the indicated, overall deposition rate by roughly one-third, but a significant difference between Layers 1 to 14 and 16 to 30 remains.

It remains to be determined whether the increase in radiocarbon activity returned to normal by 8000 BP or continued until at least 10,000 BP. Either will have a tremendous impact on archeological chronologies, and especially if Stuiver's (1967) hypothesis is correct. Nevertheless, there seems to have been a decrease in the rate of deposition between Layers 16 and 30. It is suggested that this decrease reflects a climate somewhat drier than the climate of the preceding period.

Table 3. Radiocarbon dates from Mummy Cave.<sup>1</sup>

Culture Layer	Laboratory Number	Year Processed	Age BP	Date BC, AD
38	I-1074	1963	340 ± 90	1610 ± 90 AD
36	I-1009	1963	1230 ± 110	720 ± 110 AD
34	I-1075	1963	2050 ± 150	100 ± 150 BC
32	I-1427	1964	2820 ± 135	870 ± 135 BC
30	I-1428	1964	4420 ± 150	2470 ± 150 BC
30	I-1034	1963	4375 ± 180	2425 ± 180 BC
30	I-1581	1965	4170 ± 140	2220 ± 140 BC
30	I-1580	1965	4090 ± 140	2140 ± 140 BC
28	I-1429	1964	5255 ± 140	3305 ± 140 BC
28	I-1583	1965	4640 ± 140	2690 ± 140 BC
28	I-1582	1965	4170 ± 140	2220 ± 140 BC
24	I-1466	1964	5390 ± 140	3440 ± 140 BC
24	I-1584	1965	4490 ± 140	2540 ± 140 BC
21	I-1585	1965	5610 ± 280	3660 ± 280 BC
20	I-2350	1966	5800 ± 120	3850 ± 120 BC
20	I-1586	1965	5100 ± 260	3150 ± 260 BC
18	I-1587	1965	7140 ± 170	5190 ± 170 BC
17	I-2358	1966	6780 ± 130	4830 ± 130 BC
16	I-1588	1964	7630 ± 170	5680 ± 170 BC
14	I-1589	1964	7970 ± 210	6020 ± 210 BC
12	I-2354	1966	8100 ± 130	6150 ± 130 BC
10	I-2353	1966	8740 ± 140	6790 ± 140 BC
8	I-2355	1966	8430 ± 140	6480 ± 140 BC
4	I-2356	1966	9230 ± 150	7280 ± 150 BC
1	I-2378	1966	9000 ± 145	7050 ± 145 BC
?	I-1467	1964	6970 ± 320	5020 ± 320 BC

<sup>1</sup> *Senior Author's Note.* Four additional radiocarbon dates were obtained by Susan Hughes (2001). The layers, dates, and laboratory numbers are: (1) Culture Layer 11, 8136 ± 90 BP (AA-42677); (2) Culture Layer 9, 8307 ± 78 BP (AA-42678); (3) Culture Layer 8, 8465 ± 90 (AA-42679); and (4) Layer 4, 9248 ± 78 (AA-45706).

Table 4. Rates of deposition and layer ages calculated from uncorrected and corrected radiocarbon dates.

Culture Layer	Uncorrected Date	Ages from Deposition Rate <sup>1</sup>	Corrected C-14 Date <sup>2</sup>	Ages from Deposition Rate <sup>3</sup>	Corrected C-14 Date <sup>4</sup>
38	1610 ± 90 AD	—	1480 AD	—	—
37	—	—	—	—	—
36	720 ± 110 AD	—	—	—	—
35	—	—	—	—	—
34	100 ± 150 AD	—	ca. 25 BC	—	—
33	—	—	—	—	—
32	870 ± 135 BC	—	898 BC	—	1098 BC
31	—	—	—	—	—
30	2470 ± 150 BC*	—	3138 BC*	—	3338 BC
29	—	—	—	—	—
28	3305 ± 140 BC	3373 BC	4307 BC	3855 BC	4507 BC
27	—	—	—	—	—
26	—	—	—	—	—
25	—	—	—	—	—
24	3440 ± 140 BC	3986 BC	—	4340 BC	—
23	—	—	—	—	—
22	—	4191 BC	—	4502 BC	—
21	3660 ± 280 BC	4454 BC	—	4710 BC	5004 BC
20	3850 ± 120 BC	4658 BC	—	4871 BC	5270 BC
19	—	4921 BC	—	5079 BC	—
18	5190 ± 170 BC	5446 BC	—	5495 BC	7146 BC
17	4830 ± 130 BC	5592 BC	—	5611 BC	—
16	5680 ± 170 BC*	—	—	—	7832 BC
15	—	—	—	—	—
14	6020 ± 210 BC*	—	—	—	8308 BC
13	—	6127 BC	—	—	—
12	6150 ± 130 BC	6238 BC	—	—	8490 BC
11	—	6331 BC	—	—	—
10	6790 ± 140 BC	6443 BC	—	—	—
9	—	6508 BC	—	—	—
8	6480 ± 140 BC	6573 BC	—	—	8952 BC
7	—	6759 BC	—	—	—
6	—	7020 BC	—	—	—
5	—	7075 BC	—	—	—
4	7280 ± 150 BC*	—	—	—	10,072 BC
3	—	7317 BC	—	—	—
2	—	7410 BC	—	—	—
1	7050 ± 145 BC	7540 BC	—	—	—

\* Marked dates were used to calculate rates of deposition.

<sup>1</sup> Ages are calculated from the rate of deposition based on uncorrected C-14 dates.

<sup>2</sup> Stuiver and Suess 1966.

<sup>3</sup> Ages are calculated from the rate of deposition based on corrected C-14 dates.

<sup>4</sup> Stuiver 1967.



## Chapter VI: Climatic Considerations

It was anticipated that evidence of any significant climatic changes would be reflected in the stratigraphy; however, the alternating sterile and cultural levels appeared complacent and not indicative of any major climatic events. The results of the palynological investigations and analysis of the faunal remains suggest a fairly uniform climate throughout the cultural history of the site.

Studies elsewhere indicate that there were several significant climatic episodes during the period of occupation of the shelter; however, the location of the site in a mountain region apparently masked the effects of these climatic changes.

Despite conclusions to the contrary (Aschmann 1958; Martin 1963), there is adequate evidence demonstrating the reality of the Altithermal. The Altithermal or Long Drought was thought to have begun about 7,500 years ago and to have lasted until 4,000 years ago (Antevs 1955:329). The beginning date seems to be correct, but more recently acquired evidence indicates a terminal date of about 3000 BC.

The existence of a cultural hiatus on the western Plains between about 5000 and 3000 BC has been recognized, and it has been suggested that the people were forced to move because of Altithermal conditions (Wedel 1964:199–200; Wormington and Forbis 1965:189–190).

A pollen sequence from Minnesota suggests the existence of prairie between about 7,200 and 5,000 years ago in a region that supported forest vegetation before and after this interval (Winter 1962:527). An Altithermal warm period is suggested by pollen profiles from central Canada (Nichols 1967:1666–1667). Malde (1964) summarizes pertinent geological, palynological, and archeological evidence and concludes:

Although prevailing ideas about uniformly dry climate during the Altithermal deserve critical scrutiny, and dates are needed for this period, conspicuous geologic signs characteristic of dry regions are too pervasive and too diverse to be ignored. Our knowledge is incomplete, but my guess is that the Altithermal was at first rather arid and then gradually became wetter.

Evidence of a cooler and more moist period beginning at about 3000 BC is accumulating. A cool, wet climate is suggested by studies of glacial geology and a pollen sequence from the San Juan Mountains of Colorado (Hubbs, Bien, and Suess 1963:271). A pollen profile from the Nebraska sandhills indicates that Hackberry Lake began to fill at about 3,000 BC (Sears 1961:2039). A cooling episode about 5,000 years ago is recorded in a pollen profile from central Canada (Nichols 1967:1666). The return of forest to the southeastern Minnesota area at about 3000 BC (Winter 1962:527) is indicative of a wetter climate.

Redfield (1967:691) notes an abrupt change in the rate of eustatic rise in sea level at around 2000 BC and says that the change "... coincides with the termination of the episode of maximum warmth and drought inferred from pollen studies, and so forth." Bloom and Stuiver (1963:334) determined that a change in the rate of eustatic rise of sea level occurred about 3,000 years ago. Shepard (1964:574) concluded that the rate of rise in sea level decreased between about 6,000 and 5,000 years ago. This latter determination is more in line with the evidence from pollen studies.

The aforementioned cultural hiatus on the western Plains ended at about 3000 BC indicating a return to a more favorable environment. A similar situation in the Great Basin is suggested by the appearance of a considerable population for the first time at about 2500 BC (Baumhoff and Heizer 1965:705).

Pollen profiles and geologic investigations strongly suggest another cool and moist period beginning about 3,000 years ago. Studies at Swan Lake in southeastern Idaho indicate a slightly cooler climate between about 1150 BC and AD 250 (Bright 1966:25). The pollen profile from Lake Ennadai in central Canada records a cooler period between 1700 BC and 650 BC (Nichols 1967:1667). The Cub Creek Pond column suggests a slightly cooler climate about 3,000 years ago. Alluvial and colluvial deposition indicating more moisture around 3,000 years ago is recorded at the Lindenmeier site in northern Colorado, Whitewater Draw, Arizona, and the Grants area of New Mexico (Haynes and Agogino 1960:21, Figure 5).

The Fairbank Drought of 500 BC (Antevs 1955:330) is reflected by erosion and slope wash at Lindenmeier, eolian sand deposition at the Scharbauer site in Texas, and a period of non-deposition near Grants, New Mexico (Haynes and Agogino 1960:21, Figure 5). Griffin suggests a drought between about 800 BC and 300 BC and says that a sterile windblown (?) soil underlying a Hopewellian period humus zone in western Kansas may correlate with this drought (Griffin 1961:713).

There is considerable evidence indicating that the period from about AD 0 to AD 1200 or 1300 was a time of adequate moisture. The well-known southwestern agricultural cultures were flourishing. Horticulture spread from the eastern Plains into eastern Colorado, western Oklahoma, and the Texas panhandle (Griffin 1961:711). Alluvial and colluvial deposition is recorded at the Lindenmeier site, Whitewater Draw, and the Grants area (Haynes and Agogino 1960:21, Figure 5).

## Chapter VII: Excavation Techniques

The excavations were directed by Robert Edgar prior to 1966. When I assumed responsibility for the investigations during the final field season, it was unnecessary to change the procedures established by Edgar, and the work continued much as it had during the preceding three field seasons. Horizontal control was maintained by use of a five-foot grid system projected over the entire shelter floor. Several permanent control points were established by marking certain grid intersections on the shelter ceiling and by placing metal rods at other intersections beyond the anticipated area of excavation. The principal grid axes were oriented to the cardinal directions. A datum for use as a vertical control was established and marked on the shelter wall in 1963; however, the nature of the stratigraphy and the large number occupation levels permitted maintenance of vertical control by natural and cultural levels.

The five-foot square formed the basic unit of excavation. Deviations from this unit were dictated by reasons of safety. Portions of squares abutting the rear wall were left in place to support loose rock encountered below the original surface. Once the stratigraphy within a vertical zone of manageable depth had been determined, excavation of adjacent units proceeded by natural and cultural layers. Profiles drawn to scale were made of the pit walls before the excavation of that unit was begun. This procedure was maintained throughout the excavations. Continuous profiles of the deposits were obtained along each north-south and east-west line.

As the excavation deepened, ultimately to a depth in excess of 30 feet, it became necessary to terrace or step the pit walls to prevent collapse. Ten-foot vertical walls were stable, but heights of 4 to 6 feet were maintained to provide an added element of safety and easy access to the lower work areas. Terraces coincided with grid lines and thus were five feet or multiples of five feet in width.

Cultural zones were removed by careful digging with trowels. The fill was then shoveled into screens of one-quarter-inch mesh. Before 1966, spoil dirt was spread along the slope below and north of the shelter. Later it was dumped over the edge of the bulldozer cut in front of the shelter. Sterile layers between occupation levels were removed with shovels. Thin non-cultural strata were removed with trowels. Some fill from sterile zones was screened. Normally, close inspection of this material was maintained while it was being shoveled into wheelbarrows.

Observations, findings, problems, etc., were recorded in a daily journal. Edgar drew plan sketches of some fire pits and made notations in reference to others. During 1966, non-artifactual features were recorded on printed forms used by the Smithsonian Institution, River Basin Surveys. Recorded information included scale plan views and profiles, mostly of fire pits.

Before excavation, the shelter floor presented a depressing picture. A large, irregular pit had been dug near the wall at the southern end of the site (Figure 4). Mounds of spoil dirt and rock were scattered about the edges of the pit (Plate 1b). The relic hunters' excavation attained maximum depth of about 2.5 feet and penetrated the upper four occupation levels. Unfortunately it was located in what proved to be the most productive part of the site.

After screening and removal of the relic hunters' backdirt, the shelter floor was mapped and the grid system was established. Unfortunately, the map was terminated at the drip line, but elevations of the highway and river were recorded. The vandals' pit was then squared to conform to the grid system and deepened to a level approximately one-half foot below the base of Culture Layer 36. A human burial was discovered during this process. Apparently a rock cairn built over the grave had discouraged the relic hunters and prevented disturbance of the burial.

During the 1963–1965 seasons the excavation proceeded by vertical levels. In 1963, the upper three cultural zones were removed. At the end of the season, square N40–45; E5–10 was excavated to a depth of 20 feet below the surface. Evidence of human occupation was apparent throughout the depth of deposits penetrated. The deep pit was shored with timbers and capped with a substantial wooden lid. The shoring was constructed in four-foot sections to permit easy removal as the excavation was deepened.

The following year, Culture Layers 29–35 were removed and Culture Layers 24 through 28 were excavated from several units. Two adjacent units, N30–35 and N35–40; E15–20, were excavated as deep as practicable. A large slab of rock prevented digging any deeper than Culture Layer 12. In 1965, Culture Layers 24 through 28 were removed from the central portion of the site.

In 1965, the disposal of backdirt became a problem when the great depth of the culture-bearing deposits was ascertained. It also became obvious that earthmoving equipment would be needed, not only to alleviate the spoil dirt problem but also to open up the excavation in order to explore deeper occupation levels. Earthmoving was accomplished in early May 1966. The work had to be completed before the tourist season since it was necessary, at times, to stop highway traffic. A bulldozer was used in cutting away the fill that was removed with a front loader and trucks (Plate 2a). It was necessary to cut a road into the talus slope north of the overhang to get the bulldozer into the shelter. Approximately five vertical feet of earth was then removed from the outer portion of the shelter floor beyond the drip line and to a level just below the base of Culture Layer 24. The slopes at either end of the site were cut back and sloped. The bulldozer was then taken down to the highway to remove the slope below the shelter. The deposit was cut back to a point just inside the drip line leaving a near-vertical wall. Sloping of the remaining fill at each side completed the operation (Plate 2b). Approximately 4,000 cubic yards of earth were removed.

Loose rocks in the ceiling of the rear wall presented a hazard to the excavation crew. Some loose slabs and rocks were pried away with hand tools, and a commercial firm was engaged to blast loose a number of large slabs precariously attached to the ceiling. Loose rock at the rear wall was particularly hazardous, and two excavators were injured during its removal. The problem became more acute as the deeper deposits were removed from the back of the shelter. Several tons of rock were removed from the wall at various times, but a completely stable condition was never achieved. Apparently, removal of the supporting earth caused further exfoliation of the rock as described earlier in the geology of the site. Protective headgear, constant surveillance of the rocks, and intermittent removal of unstable slabs and blocks kept danger to a minimum.

A constant flow of spectators necessitated the building of fences around the work area to prevent damage to the excavations and possible injury to the visitors. Barbed wire fences were erected across the front of the shelter at road level and just inside the overhang at the end of the upper access trail. From the latter location visitors could view the excavations from above without interfering with the work.

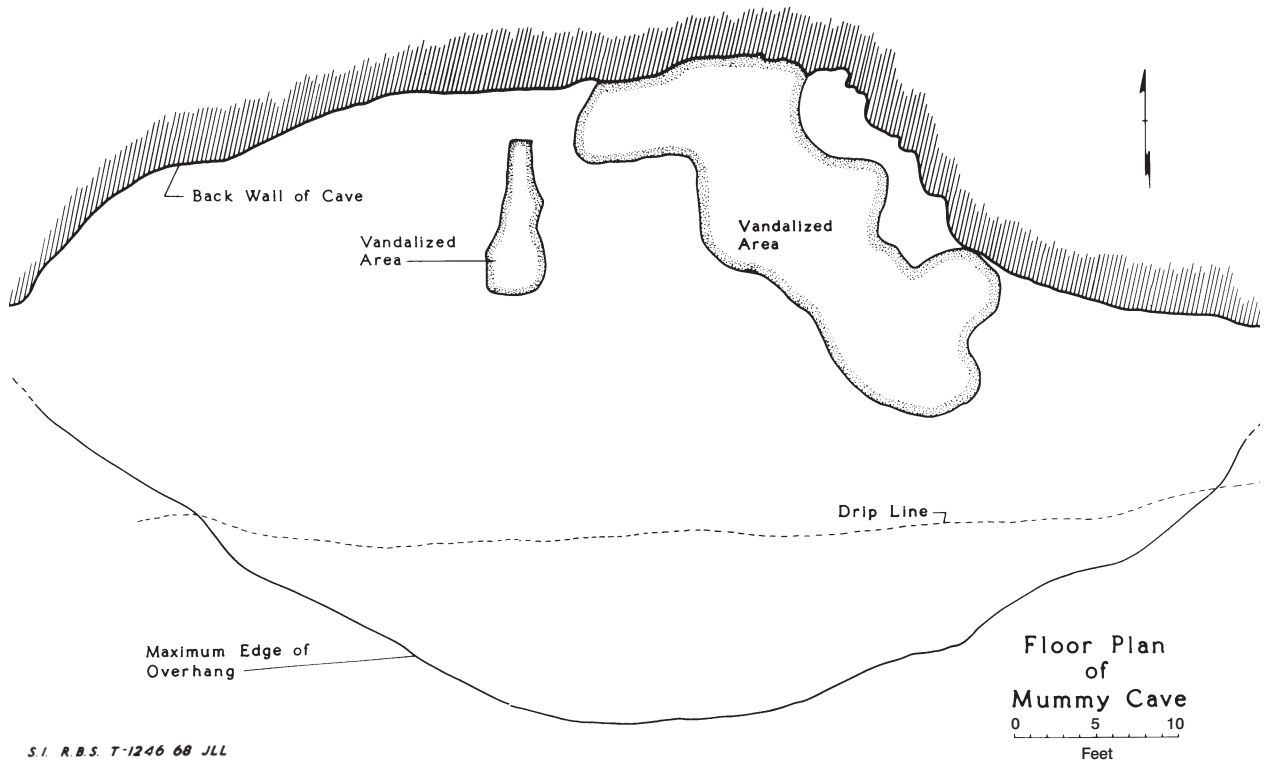


Figure 4. Floor plan of Mummy Cave.





## Chapter VIII: The Evidence

The unusual number and near ideal stratification of the occupation levels within Mummy Cave provide an exceptional opportunity to study a basic sequence of archeological complexes and assemblages in the central Rocky Mountains. The principal interests in the artifacts involve morphology, age, and geographical distribution. In the west, these three elements are expressed most revealingly by the projectile point, although certain other artifacts have diagnostic value of lesser sensitivity.

In this report, a type is regarded as a distinctive form occurring in a definable stratigraphic or temporal context, and having demonstrable geographic spatial distribution. As such, a projectile point type in Mummy Cave is essentially the major point form found in a particular occupation stratum. More than one projectile point type occasionally occurred in one layer, but with few exceptions, each cultural level contained one predominant form.

Classification of the artifacts began with the segregation of the various implements into functional categories such as knives, scrapers, awls, flakers, and the like. Each category was then separated into groups of like objects on the basis of certain morphological features and labeled by a descriptive term derived from one or more morphological characteristics or the material from which the implement was made. Groups such as ulna awls, trianguloid knives, and eared, indented base projectile points resulted. These may be regarded as types. If a type has been named in the literature, the name is incorporated in the descriptions, and in some instances, new type names have been proposed.

It will be noted below that several layers produced no artifacts. Others contained only fire pits or scraps of cut animal bone. Although a layer may not have yielded any recognizable tools or other obvious evidence of man's labors, such as prepared fire pits, charcoal concentrated in the layer and occasional small scraps of bone attest to human presence. Keeping in mind the numbering of the occupation levels consecutively from the lowest, Culture Layers 2, 3, 5, 26, 27, 31, 33, and 35 produced no evidence of occupation beyond the presence of a charcoal-stained layer or lens.

### CULTURE LAYER 1

#### *Radiocarbon Date*

Whenever possible, charcoal samples for possible radiocarbon dating were taken from fire pits. This was not possible in Culture Layer 1, and the sample consisted of many tiny fragments of charcoal concentrated in grid units N25-30; W0-5 and N30-35; W0-5. The concentration was indicative of a fire pit or surface fire, but we were unable to determine a pit outline or fire area.

An aliquot of the charcoal sample produced a radiocarbon date of  $9000 \pm 145$  BP (I-2378). The date is considered to be too recent.

#### *Artifacts*

##### **Chipped Stone**

**Blade** (one specimen, Plate 7a). This is a thick, curved, prismatic blade. The distal end, that opposite the striking platform, terminates in a hinge fracture. The striking platform was removed as a result of striking several large flakes from one edge to form a point. The point is slightly dulled from use, apparently as a graver. Both lateral edges bear uneven, discontinuous use flake scars. Two short, broad, longitudinal flakes were removed from the dorsal surface at the distal end, apparently to thin the dorsal ridge. A small area of cortex is retained on one side of the dorsal surface at the distal end. There is some slight battering of the dorsal ridge. 87.0 mm long, 22.0 mm wide, 11.0 mm thick; chert.

## CULTURE LAYER 4

### *Feature*

**Fire Area.** A small fire had been built on the ground surface beside a rock. No preparation of the ground had been made. The remains consisted merely of a circular concentration of dense white ash and charcoal. Length 80.0 cm, width 75.0 cm. Charcoal from the fire area gave a radiocarbon age of  $9230 \pm 150$  BP (I-2356).

### *Artifacts*

#### **Chipped Stone**

**Lanceolate, Concave Base** (one specimen, Plate 7b). A small lanceolate projectile point made on a curved flake. The lateral edges are convex and constricted a short distance above the base, which is smoothly concave. Parallel-oblique flaking of mediocre quality is present on both faces. There is some discontinuous edge retouch. The specimen is biconvex in cross section. The basal edge and the lateral edges are smoothed. Lateral smoothing extends from the base to about the midpoint. Length 42.0 mm, width 15.0 mm, thickness 5. mm; chert.

#### **Bone**

**Incised Bone** (one specimen, Plate 7e). A part of the hyoid bone of an artiodactyl (*Ovis* or *Odocoileus*) with five parallel incised lines near the larger end. The outer lines are 8.0 mm and 5.0 mm long. The three inner lines are 1.0 to 2.0 mm long. Length 74.0 mm, width 15.0 mm, thickness 3.0 mm.

**Cut Bone** (one specimen). A short piece of mammal long bone bears various random light cutting marks.

## CULTURE LAYER 6

### *Features*

**Fire Pits 2–5.** Shallow oval to circular basins containing ashy earth and scattered bits of charcoal. Two contained bits of bone and one produced a few stone flakes. Fire Pit 2 was 42.5 cm long, 42.5 cm wide, 11.25 cm deep. Fire Pit 3 was 80.0 cm long, 60.0 cm wide, 12.5 cm deep. Fire Pit 4 was 42.5 cm in diameter, 8.75 cm deep. Fire Pit 5 was 42.5 cm long, 40.0 cm wide, 10.5 cm deep.

**Fire Pit 6.** An oval bowl or kettle-like fire pit filled with ashy earth and occasional flecks of charcoal. Greater depth distinguishes this pit from the above four. 56.0 cm long, 47.5 cm wide, 20.0 cm deep.

### *Artifacts*

#### **Chipped Stone**

**Graver** (one specimen, Plate 7c). A graver point chipped on what appears to have been a poorly made projectile point. The lateral edges are weakly convex. One end is broken transversely. A short, sharp graver tip is chipped into the opposite end. Both faces exhibit poorly controlled parallel-oblique flaking. There is some retouching of the edges. The specimen is plano-convex in cross section. Length 45.0 mm, width 17.0 mm, thickness 6.0 mm; chert.

#### **Bone**

**Rodent Tibia Awl** (one specimen, Plate 7d). The shaft of a rodent tibia, probably pack rat, used for an awl. The articular surfaces and projecting fibula were removed. The distal end was pointed and polished, but the medullary cavity prevented the formation of a sharp point. Possibly the articular surface of the proximal end was retained. If so, it may have been broken off during use. The broken end is unaltered. Length 27.0 mm, width 3.0 mm, thickness 2.0 mm.

**Splinter Awls** (two specimens, Plate 7g, h). One is a splinter of long bone with a narrow, polished tip at one end. The extreme tip is missing. The tip is triangular in cross section, and two of the faces bear oblique parallel striations made during shaping of the tip. The proximal end bears smoothing striations parallel with the longitudinal axis. The rough proximal end is not smoothed. Length 69.0 mm, width 9.0 mm, thickness 5.5 mm.

The second is probably the proximal half of a splinter awl. It is a narrow section of long bone bearing parallel polishing striations and oblique striations at the distal end. The rough proximal end is lightly smoothed. The awl probably was at least 90.0 mm long. Length 53.0 mm, width 6.0 mm, thickness 3.0 mm.

**Flaker** (one specimen, Plate 7f). This is probably a broken flaker. It is a section of long bone bearing numerous deep striations along most of one edge and an end. The opposite edge has a small rounded and polished projection at the scarred end. Proximal to the projection are several rough parallel striations along the broken edge of the bone. Apparently the distal end is missing. The rough proximal end is crudely smoothed. Length 122.0 mm, width 16.0 mm, thickness 6.0 mm.

**Cut Bone** (one specimen). A short, semicircular section of long bone bearing numerous random cut marks, probably made during butchering.

## CULTURE LAYER 7

### *Features*

**Fire Pits 7 and 8.** Shallow, oval pits containing ashy earth and charcoal flecks. They are identical to Fire Pits 2–5 in Culture Layer 6. Fire Pit 7 was 45.0 cm long, 37.5 cm wide, 3.75 cm deep. Fire Pit 8 was of undetermined length, 45.0 cm wide, 5.0 cm deep.

### *Artifacts*

#### **Bone**

**Cut Bone** (two specimens, Plate 7i). Two sections of unidentified mammal long bone with random cut marks on the exterior surfaces.

## CULTURE LAYER 8

### *Features*

**Fire Pits 9–12.** Four shallow basins, oval to circular, identical in form and content to Fire Pits 2–5 in Culture Layer 6. Fire Pit 9 was 30.0 cm in diameter, 10.0 cm deep. Fire Pit 10 was 35 cm long, 32.5 cm wide, 7.5 cm deep. Fire Pit 11 was 110.0 cm long, 82.5 cm wide, 6.0 cm deep. Fire Pit 12 was 37.5 cm long, 35.0 cm wide, 6.25 cm deep. Charcoal from Fire Pit 11 produced a radiocarbon age of  $8430 \pm 140$  BP (I-2355).

**Fire Pits 13–19.** Seven fire pits identical in form to Fire Pit 6 in Culture Layer 6. Like the latter, all were filled with ash, ashy earth, and charcoal flecks. Fire Pit 13 was of undetermined length, 40.0 cm wide, 15.0 cm deep. Fire Pit 14 was 32.5 cm in diameter, 20.0 cm deep. Fire Pit 15 was 42.5 cm in diameter, 17.5 cm deep. Fire Pit 16 was 50.0 cm in diameter, 22.5 cm deep. Fire Pit 17 was 40.0 cm long, 37.5 cm wide, 12.5 cm deep. Fire Pit 18 was 45.0 cm long, 40.0 cm wide, 15.0 cm deep. Fire Pit 19 was 37.5 cm long, 30.0 cm wide, 12.5 cm deep.

### *Artifacts*

#### **Chipped Stone**

**Lanceolate, Narrow, Concave Base** (one specimen, Plate 8p). This specimen is identical to those projectile points in Culture Layer 9. The type description is provided in the description of artifacts from Culture Layer 9. The specimen is too fragmentary to measure adequately; obsidian.

**Lanceolate, Narrow, Straight Base** (six specimens, Plate 8o, q–s, u, x). These are lanceolate projectile points with convex edges converging to narrow, straight bases. With one exception they are chipped overall. The flaking varies from parallel-oblique to random. Edges are retouched; the lateral edges are ground smooth one-fourth to one-third the length from the base; cross sections are biconvex.

One specimen is made on a plano-convex flake and much of the planar face is chipped only along the edges. Another (Plate 8x) is alternately beveled from tip to midpoint. The bevel is on the right. Two complete specimens are 61.0 and 50.0 mm long, 17.0 and 21.0 mm wide, and 5.0 and 7.0 mm thick, respectively. The broken specimens are of comparable size; quartzite (three), chert (one), obsidian (one).

**Lanceolate, Flat Base** (one specimen, Plate 8w). This projectile point is similar to the above two projectile point classes but has a base consisting of a flat plane. The example could be broken; however, the striking platform on the original flake from which the point was made appears to form the base. The lateral edges are ground. Length 55.0 mm (estimated), width 19.0 mm (estimated), thickness 6.5 mm; chert.

**Crude Scraper** (one specimen, Plate 9j). A roughly ovate, crudely flaked implement with irregularly chipped edges. The ventral surface is essentially flat. The dorsal surface is convex and bears large flake scars and small areas of cortex. Length 69.0 mm, width 50.0 mm, thickness 21.0 mm; chert.

**Small Chopper** (one specimen, Plate 9k). A small, ovate, bifacially chipped chopper with sinuous lateral edges. It is thick and roughly biconvex in cross section. Length 74.0 mm, width 50.0 mm, thickness 23.0 mm.

**Cobble Chopper** (one specimen, Plate 12g). A flat oval cobble with a few percussion flakes removed from one side to form a sinuous cutting or chopping edge. Length 132.0 mm, width 109.0 mm, thickness 55.0 mm; igneous rock.

**Hammerstone?** (one specimen, Plate 12i). An ovate cobble with slightly pitted areas at each end. Length 162.0 mm, width 81.0 mm, thickness 62.0 mm; igneous rock.

**Sharpening Stone?** (one specimen, Plate 12h). A flat semicircular cobble bearing several shallow, narrow, V-shaped grooves. It may have been used to sharpen tools or possibly to dull the edges of projectile points. Length 100.0 mm, width 82.0 mm, thickness 36.0 mm; igneous rock.

## **Bone**

**Polished Awl** (one specimen, Plate 11d). A long and narrow awl, circular in cross section. The proximal end is flattened and minimally smoothed. The tip is missing. Length is about 140.0 mm, width 8.0 mm, thickness 5.0 mm.

**Awl Midsection** (one specimen, Plate 11i). A short section of a narrow awl with an oval midsection. Length 21.0 mm, width 2.0 mm, thickness 1.5 mm.

**Cut Bone** (three specimens). Three sections of split mammal long bone bear parallel and random cut marks.

## **CULTURE LAYER 9**

### ***Features***

**Fire Pits 20 and 21.** Oval, bowl-shaped fire pits identical to Fire Pits 2–5 in Culture Layer 6 and Fire Pits 13–19 in Culture Layer 8. Both contained ashy earth and bits of charcoal. Small bone fragments and a few stone flakes were collected from each. Fire Pit 20 was 42.5 cm long, 40.0 cm wide, 22.5 cm deep. Fire Pit 21 was 55.0 cm long, 40.0 cm wide, 25.0 cm deep.

### ***Artifacts***

#### **Chipped Stone**

**Lanceolate, Narrow, Concave Base** (three specimens, Plate 8j–l). Lanceolate projectile points with lateral edges expanding gradually from narrow, straight bases. Flaking is generally random but occasion-

ally there is a suggestion of parallel-oblique chipping. Lateral edges are retouched and bases are thinned. Lateral edges are ground one-fourth to one-third the length from the base. Cross sections are biconvex. Length 65.0 mm to 60.0 mm (estimated), width 23.0 to 18.0 mm (estimated), thickness 7.0 to 6.0 mm; chert (one), fossil wood (one), obsidian (one).

**Lanceolate, Convex Base** (one specimen, Plate 8i). This is the basal portion of a projectile point with nearly straight lateral edges and a convex base. Flaking is parallel and transverse. The base is thinned and the lateral edges are smoothed. Length 75.0 mm (estimated), width 21.0 mm (estimated), thickness 7.5 mm; obsidian. The specimen agrees with the description of the Agate Basin point (Roberts 1961).

**Lanceolate, Flat Base** (one specimen, Plate 8n). This is identical to the point from Culture Layer 8 described above. Length 65.0 mm (estimated), width 20.0 mm (estimated), thickness 7.0 mm; obsidian.

**Miscellaneous** (one specimen). The distal portion of a point with convex lateral edges and parallel-oblique flaking. The lateral edges are smoothed near the break. The cross section is biconvex. Length 65.0 mm (estimated), width 18.5 mm, thickness 6.0 mm; chert.

**Utilized Flakes** (two specimens, Plate 9f). One oval and one trianguloid stone flake with minute use flake scars along one edge. There is no evidence of intentional modification. Length 37.0 and 30.0 mm, thickness 21.0 and 28.0 mm, thickness 8.0 and 5.0 mm, respectively; chalcedony (one), chert (one).

## **Bone**

**Polished Awl** (one specimen, Plate 11a). This is a very well made awl of mammal long bone. The proximal end is squared and the edges rounded and polished. The shaft tapers gradually from the butt and is polished. The tip is missing. The proximal end is oval in cross section; the opposite end is round. The awl must have been about 125.0 mm long. Length about 125.0 mm (estimated), width 8.0 mm, thickness 5.0 mm.

**Splinter Awl** (one specimen, Plate 11c). This appears to be a splinter from the anterior end of a scapula. One end tapers to a sharp smoothed point. The remainder is unaltered. Length 57.0 mm, width 11.0 mm, thickness 5.0mm.

**Awl Tip** (one specimen, Plate 11h). The highly polished tip of an awl, round in cross section. Length 18.0 mm, diameter 3.5 mm.

**Cut Bone** (seven specimens). Pieces of split and shattered mammal long bone with various random cut marks.

## **CULTURE LAYER 10**

### ***Features***

**Fire Pit 22.** The single fire pit in this stratum was a circular, bowl-shaped pit filled with ash, earth, and flecks of charcoal. A few stone chips were found in the fire pit fill. The pit is identical in form and content to Fire Pits 13–19 in Culture Layer 8. 60.0 cm long, 57.5 cm wide, 22.5 cm deep. A radiocarbon date of  $8740 \pm 140$  BP (I-2353) was obtained from charcoal from this pit.

**Rock Alignment.** A continuous line of three stone slabs set on edge was uncovered in square N25–30; E5–10 (Plate 4b). Two small rocks rested against the downslope side of the largest or longest slab as if to support it in a vertical position. The alignment was 5.5 feet (1.68 m) in length and averaged approximately 10 inches (25.4 cm) in height.

A portion of a mountain sheep skull was lying to the south on the upslope side of the alignment, but as far as could be determined, it was associated with the next higher occupation stratum, Culture Layer 11. It is possible that earth was piled against the uphill side of the slabs to support them. If so, the sheep skull could have been associated with Layer 10. In this portion of the shelter, the layers were thin and indistinct, and the association of the skull is tenuous at best.

That the slabs were purposely erected seems conclusive. The probabilities of the three slabs naturally coming to rest on edge are extremely low. The purpose of the alignment is conjectural. If the skull was associated, it may have been a shrine. Since it was erected near the base of a rather steep slope, it might have served as a retaining wall or deflector to prevent water or talus from entering the living area.

## *Artifacts*

### **Chipped Stone**

**Lanceolate, Narrow, Concave Base** (seven specimens, Plate 8d–h, m). Identical to the three projectile points from Culture Layer 9 described above. One basal fragment (Plate 8g) exhibits two burin points, one on each edge at the point of breakage. One flake was removed longitudinally from each edge toward the base. The broken edge is roughly reworked on one face. One complete specimen measures 50.0 mm long, 17.0 mm wide, and 7.5 mm thick. Four fragments appear to have been from larger points. Two appear to have been smaller; chert (two), fossil wood (two), chalcedony (one), quartzite (one), siltstone (one).

**Knife** (one specimen, Plate 9i). A fragment of a bifacially flaked knife with convex edges. The end is bluntly pointed. Both faces are flaked overall, and the edges are bifacially retouched. The cross section is biconvex. At least half — and probably more — is missing. Length 49.0 mm, width 46.0 mm, thickness 11.0 mm; quartzite.

**Side Scraper** (one specimen, Plate 9h). This is a thick trianguloid flake of stone with unifacial flaking along one convex edge and along half of the opposite edge. The flaked edges converge to a sharp point that may have served as a graver; however, it bears no evidence of use. The base is flat and unaltered. The cross section is triangular. Length 57.0 mm, width 32.0 mm, thickness 13.0 mm; fossil wood.

**Flake Scrapers** (two specimens). Two ovate flakes with short areas of unifacial flaking along one edge. They show no other evidence of use. Length 53.0 and 52.0 mm, width 43.0 and 34.0 mm, thickness 10.0 and 9.0 mm, respectively; fossil wood.

**Graver** (one specimen). An oval plano-convex flake with a small graver tip at one end. The point was formed by unifacial chipping on the dorsal surface of the flake. The dorsal surface is nodular cortex. The ventral surface has a bulb of percussion at the end bearing the graver. Length 38.0 mm, width 23.0 mm, thickness 6.0 mm; chert.

**Chopper** (one specimen, Plate 9g). Approximately one-half the periphery of a thick, ovate flake driven from a cobble with a rough, sinuous, percussion-flaked edge. About half of this edge is unifacially retouched. The dorsal surface bears large percussion flake scars and an area of cobble cortex. The ventral surface is entirely percussion flaked. Length 69.0 mm, width 51.0 mm, thickness 30.0 mm; fossil wood.

**Utilized Flakes** (three specimens). Small rectanguloid flakes with small use flake scars along one edge. Length 33.0 and 28.0 mm, width 21.0 and 20.0 mm, thickness 9.0 and 3.5 mm, respectively; fossil wood (two), quartzite (one).

### **Rough Stone**

**Cobble Chopper** (one specimen, Plate 12f). A flat, rectanguloid cobble with bifacial percussion flaking along one edge. This edge is battered and dulled from use. Length 126.0 mm, width 109.0 mm, thickness 59.0 mm; volcanic rock.

**Hammerstone** (one specimen, Plate 12e). An ovoid cobble pitted at both ends. Length 94.0 mm, width 60.0 mm, thickness 41.0 mm; igneous rock.

### **Bone**

**Awl Base** (one specimen, Plate 11j). This appears to be the proximal portion of an awl with an expanding base. The shaft is small and round in cross section. Approximately 8.0 mm from the base, the shaft flattens and the edges diverge to form the base. The end was roughly broken and the edge was sub-

sequently smoothed. The awl probably was twice as long as the basal fragment. Length 31.0 mm, diameter 2.5 mm, width of base 6.0 mm.

**Needle** (one specimen, Plate 11k). The proximal end of a small, well-made needle with an oval eye. The shaft is round in cross section but flattens within 5.0 mm of the end. The eye is in the flattened portion less than 1.0 mm from the end. The eye is 1.0 mm in length and about 0.5 mm wide. The entire needle is highly polished. It probably was 55.0 mm to 60.0 mm long when complete. Length 38.0 mm, diameter 1.5 mm.

**Cut Bone** (six specimens). Five pieces of split mammal long bone and a section of rib with random cut marks probably made during butchering.

## CULTURE LAYER 11

### *Features*

**Fire Pits 23–25.** These three specimens are identical to Fire Pits 13–19 in Culture Layer 8. Fire Pit 25 was more than twice as large as Fire Pits 23 and 24, but it was essentially the same in construction and content. Fire Pit 23 was 32.5 cm in diameter, 18.75 cm deep; Fire Pit 24 was 35.0 cm in diameter, 16.25 cm deep; Fire Pit 25 was 87.5 cm long, 75.0 cm wide, 20.0 cm deep.

### *Artifacts*

#### **Chipped Stone**

**Lanceolate, Flat Base** (one specimen, Plate 8c). This projectile point is similar to those of the same class in Culture Layers 8 and 9 but more complete. The lateral edges are serrated from the midpoint toward the tip. Flaking is random and poorly controlled. The cross section is thick and biconvex. Lateral edges are ground from the base to a point near the middle. There is some minor flaking on both faces of the base. Length 49.0 mm (estimated), width 18.0 mm, thickness 8.0 mm; basalt.

**Miscellaneous** (two specimens). These are badly shattered apical projectile point fragments lacking tips. One is obliquely flaked and serrated. The other is randomly chipped. Not measurable; fossil wood (one), quartzite (one).

**Side Scraper** (one specimen, Plate 9d). A thin, curved, trianguloid flake with even unifacial retouching along one edge. It is otherwise unaltered. Length 63.0 mm, width 44.0 mm, thickness 7.0 mm; chert.

**Chopper** (one specimen, Plate 9c). This is a thick core-like piece of broken cobble with two rough sinuous cutting or chopping edges. They are not retouched. One surface is cobble cortex. The other bears percussion flake scars. Length 66.0 mm, width 59.0 mm, thickness 25.0 mm; fossil wood.

**Utilized Flake** (one specimen). A small, trianguloid flake has one long naturally beaked edge. This edge is covered with minute use flake scars. Length 23.0 mm, width 16.0 mm, thickness 6.0 mm; fossil wood.

#### **Rough Stone**

**Cobble Choppers** (two specimens, Plate 12c, d). Smoothed and rounded river cobbles with sinuous, bifacially chipped working edges at one end. Both cobbles are naturally thin and only a small amount of flaking was necessary to form the working edges. The bits are battered and dulled from use. Length 146.0 and 140.0 mm, width 99.0 and 90.0 mm, thickness 35.0 and 48.0 mm, respectively; felsite and felsophyre.

**Edge-Battered Cobble** (one specimen). A smooth, ovate cobble with an oval and lightly pitted area on one lateral edge measuring 50.0 mm by 25.0 mm. It appears to have been used as a crushing tool. Length 112.0 mm, width 84.0 mm, thickness 64.0 mm; felsite.



## Bone

**Awl or Needle Tips** (two specimens, Plate 11e, g). Polished shafts of needles or awls with the extreme tips missing. Their small sizes suggest that they may have been needles. Length 31.0 and 25.0 mm, width 3.0 and 2.0 mm, thickness 2.0 and 1.5 mm, respectively.

**Needle** (one specimen, Plate 11f). Similar to the needle from Culture Layer 10. The entire shaft is oval. The eye is 2.0 mm long and about 0.75 mm wide. It is placed 2.5 mm from the end. The distal portion is missing. Length 26.0 mm, width 2.0 mm, thickness 1.5 mm.

**Cut Bone** (six specimens). Fragments of long bone bearing various parallel and random cutting marks, probably the result of butchering.

## CULTURE LAYER 12

### *Features*

**Fire Pit 26.** An oval, bowl-shaped fire pit identical in form and content to Fire Pits 13–19 in Culture Layer 8. 52.5 cm long, 44.0 cm wide, 16.25 cm deep.

**Fire Pit 27.** A small, circular fire pit with vertical walls and a nearly level bottom. It was filled with ashy earth and scattered bits of charcoal. It was 25.0 cm in diameter, 30.0 cm deep.

**Fire Pit 28.** The remains of a fire built on the surface of the ground. It appeared as an irregularly shaped accumulation of ash, charcoal-stained earth, and bits of charcoal. It was ca. 60.0 cm in diameter, 5.0 cm thick. A charcoal sample from the fire area gave a radiocarbon age of  $8100 \pm 130$  BP (I-2354).

### *Artifacts*

#### Chipped Stone

**Lanceolate, Narrow, Concave Base** (one specimen, Plate 8a). Identical to projectile points in Culture Layers 8, 9, and 10. It is the proximal half of a large projectile point with smoothly convex edges. The edges expand from a narrow, concave base to the widest point near mid-blade. The basal concavity is shallow. Flaking is parallel-oblique and only of fair quality. The edges are retouched. The lateral edges are lightly smoothed for a distance of about one-third the total length. The cross section is biconvex. Length 80.0 mm (estimated), width 26.0 mm, thickness 7.0 mm; quartzite.

**Lanceolate, Narrow, Straight Base** (one specimen, Plate 8b). A basal fragment identical to projectile points of this class in Culture Layers 8, 9, and 10. Length undetermined, width 18.0 mm, thickness 5.0 mm; obsidian.

**Knives** (two specimens, Plate 9b). Both are broken. One specimen appears to be the distal end of an asymmetric knife with one slightly convex edge and one strongly convex edge. It is roughly percussion-flaked on both faces. Both edges are bifacially retouched, but the weakly curved edge is roughly serrated or notched. The notching was accomplished subsequent to retouching. Multiple use flake scars are present at the bottom of the three lateral notches. The cross section is biconvex. Length 71.0 mm, width 41.0 mm, thickness 12.0 mm; quartzite.

The other is a small triangular fragment of a bifacially flaked and retouched knife. Its former shape is undetermined. Length 37.0 mm, width 31.0 mm, thickness 9.0 mm; quartzite.

**Utilized Core** (one specimen, Plate 9e). Use flake scars are evident along one edge of a roughly ovate core. The flake scars are small and appear to have resulted from scraping. Length 65.0 mm, width 53.0 mm, thickness 31.0 mm; chalcedony.

## **Rough Stone**

**Cobble Chopper** (one specimen, Plate 12a). A flat ovate river cobble with two large percussion flakes removed from alternate faces at one end to form a sinuous cutting edge. Length 174.0 mm, width 132.0 mm, thickness 55.0 mm; igneous rock.

**Hammerstones** (two specimens, Plate 9a, Plate 12b). One is a fist-sized, flat, oval cobble with small pitted areas at each end. The other specimen is a small ovate pebble battered and pitted at both ends. Length 110.0 and 66.0 mm, width 97.0 and 42.0 mm, thickness 47.0 and 27.0 mm, respectively; volcanic rock (larger), igneous rock (smaller).

## **Bone**

**Cut Bone** (two specimens). These pieces of split mammal long bone have various random cut marks apparently made during butchering.

## **CULTURE LAYER 13**

### *Feature*

**Fire Pit 29.** A circular area of burned silt overlain by a thin layer of charcoal-stained earth. The fire was built beside a large, irregularly shaped rock. The pit was 75.0 cm long, 60.0 cm wide, 2.5 cm thick.

### *Artifacts*

#### **Chipped Stone**

**Graver** (one specimen). A small plano-convex flake with a triangular projection. The tip of the projection is sharp and bears evidence of use as a graver. The sharply curved edge below the projection has fine unifacial retouching and appears to have served a scraping function. Length 26.0 mm, width 20.0 mm, thickness 4.0 mm; chert.

## **Bone**

**Cut Bone** (one specimen). A few cutting marks are visible on a narrow piece of split mammal long bone.

## **CULTURE LAYER 14**

### *Feature*

**Fire Pit 30.** A shallow, nearly circular, basin-shaped fire pit filled with dense white ash and occasional flecks of charcoal. The charcoal was concentrated near the bottom and the periphery of the depression. A few stone flakes were recovered from the pit fill. The pit was 55.0 cm long, 50.0 cm wide, 8.75 cm deep.

### *Artifacts*

#### **Chipped Stone**

**Lovell Constricted Point** (one specimen, Plate 10a). A lanceolate projectile point with constriction of the lateral edges just above the base resulting in a slight fish-tail appearance. The base is concave. Flaking is of the parallel-oblique variety but poorly executed. Lateral edges are retouched. The cross section is biconvex. This specimen was broken and later reworked. At least one edge flared markedly above the constriction. A burin-blow removed a longitudinal flake from this edge. The distal end was reworked to a blunt point, and the burin point also was modified by fine flaking. One basal ear is missing. Length 51.0 mm, width 20.5 mm, thickness 7.0 mm; quartzite.

**Knife Chopper** (one specimen, Plate 10d). A thick, rectanguloid flake with one percussion-flaked, sinuous, convex edge. There is a small amount of unifacial retouching at one end of this edge. The im-

plement appears to have been used for cutting or chopping. Length 56.0 mm, width 48.0 mm, thickness 15.0 mm; fossil wood.

**Small Biface** (one specimen). A panduriform implement, bifacially chipped, with intermittent unifacial retouching at both ends. One of the concave lateral edges has some rough unifacial retouching. It is biconvex in cross section. Length 30.0 mm, width 23.0 mm, thickness 10.0 mm; fossil wood.

### Scrapers

**Ovate End Scraper** (one specimen, Plate 10b). A small, ovate, high-angle end scraper made on a flake. The flake is triangular in longitudinal section with the apex above the scraping edge. The bit is semicircular and finely retouched. Both lateral edges and the basal edge are haphazardly retouched. Length 28.0 mm, width 20.0 mm, thickness 7.0 mm; chert

**Rectangular End Scraper** (one specimen, Plate 10h). A thick, rectangular, block-like piece of stone, trapezoidal in cross section. One convex edge has a crudely chipped high-angle scraping edge. The remainder is unaltered. Length 48.0 mm, width 45.0 mm, thickness 26.0 mm; fossil wood.

**Flake Scraper** (one specimen, Plate 10e). A thin, rectangular, blade-like flake with even unifacial retouching along one uneven lateral edge. There is a small amount of unifacial retouching at one end. Length 47.0 mm, width 24.0 mm, thickness 5.0 mm; fossil wood.

**Miscellaneous** (one specimen). A triangular fragment of a side or end scraper. One edge is unifacially retouched forming a rough scraping edge. Length 24.0 mm, width 24.0 mm, thickness 14.0 mm; fossil wood.

**Graver** (one specimen, Plate 10j). One end of a thick hexagonal flake with a roughly chipped triangular point at one end. It resembles the tip of a projectile point and appears to have been used as a graver. Length 57.0 mm, width 34.0 mm, thickness 10.0 mm; fossil wood.

**Modified Flakes** (two specimens, Plate 10c). One large, thick, ovate flake and one small, thin, triangular flake with fine pressure retouching along one edge. The larger specimen may have served as a knife. Length 55.0 and 34.0 mm, width 42.0 and 20.0 mm, thickness 17.0 and 4.0 mm, respectively; fossil wood.

**Choppers** (two specimens, Plate 10f, g). One specimen is a thick, ovate, bifacially chipped implement with rough sinuous edges. It shows little evidence of use. The other appears to be part of a broken ovate or circular percussion flaked chopper with a sinuous edge. The edge of the fragment is battered. Length 63.0 and 58.0 mm, width 37.0 and 22.0 mm, thickness 20.0 and 17.0 mm, respectively; fossil wood.

### Bone

**Cut Bone** (one specimen). A small portion of the pelvis of *Ovis canadensis* bears numerous cutting marks.

## CULTURE LAYER 15

### Features

**Fire Pit 31.** A shallow, kidney-shaped, basin-like fire pit. It contained a layer of white ash overlaying a thin layer of burned earth that in turn overlay charcoal-stained earth. It was 82.5 cm long, 67.5 cm wide, 7.5 cm deep.

**Fire Pit 32.** A circular area of dense white ash covering an area of burned earth. 60.0 cm long, 55.0 cm wide, 1.25 cm thick.

## *Artifacts*

### **Chipped Stone**

**Chopper Scraper** (one specimen, Plate 10i). A large, thick, pentagonal, plano-convex flake with an uneven unifacially retouched chopping and/or scraping edge at one end. The bit is roughly serrated. Length 74.0 mm, width 60.0 mm, thickness 27.0 mm; chert.

**Core** (one specimen). A triangular piece of stone roughly pentagonal in cross section. It bears several facets formed by the removal of long narrow flakes. Length 65.0 mm, width 44.0 mm, thickness 30.0 mm; fossil wood.

## **CULTURE LAYER 16**

### *Features*

**Fire Pit 33.** A large, shallow, circular, basin-shaped depression. Charcoal-stained sand and bits of charcoal covered the bottom. This material was covered by a thin layer of burned earth that was in turn covered by dense white ash. A few bone fragments and stone chips were found in the fire pit fill. 105.0 cm diameter, 12.5 cm deep.

**Fire Pit 34.** A small, shallow, oval, basin-shaped fire pit identical to Fire Pits 2–5 in Culture Layer 6. It contained ash, charcoal-stained earth, and flecks of charcoal; this pit was 42.5 cm long, 32.5 cm wide, 10.0 cm deep.

**Fire Pit 35.** A small elongate concentration of ash and charcoal on the contemporary ground surface. Length undetermined, 10.0 cm wide, 1.9 cm thick.

## *Artifacts*

### **Chipped Stone**

**Blackwater Side-Notched** (five specimens, Plate 13 a–d). The projectile point specimens in this group are triangular with straight to convex lateral edges and straight to weakly convex basal edges. Deep, wide side notches are placed near the base and oriented at a low angle toward the tip. The sharply expanding stems have rounded tips. The points are moderately thick and biconvex in cross section. Chipping is good, and all edges are retouched. The basal edges are lightly ground. Length 39.0 to 29.0 mm, width 23.0 to 21.0 mm, thickness 5.5 to 4.5 mm; obsidian (two), chalcedony (one), chert (one), fossil wood (one).

**Pahaska Side-Notched** (one specimen, Plate 13f). A side-notched projectile point with weakly convex lateral edges and a slightly concave base. The notches are deep and wide and oriented parallel to the basal edge. The cross section is smoothly lenticular. Chipping is well controlled. The lateral edges are retouched and the base is bifacially thinned. The basal edge is lightly ground. Length 45.0 mm (estimated), width 21.0 mm, thickness 5.0 mm; chert. The type description for the Pahaska Side-Notched point is given in the description of projectile points from Culture Layer 17.

**Corner-Notched, Sharp Barbs** (one specimen, Plate 13e). A triangular projectile point with convex lateral edges and a straight base. Deep, wide notches extend from the basal corners at a high angle toward the tip forming long, sharp barbs. Chipping is very good with secondary flaking of the lateral edges. The base is bifacially thinned. Length 29.0 mm, width 23.5 mm, thickness 5.0 mm; quartzite. The point may be a variant of the Blackwater Side-Notched type.

**Expanding Stem, Sharp Shouldered** (one specimen, Plate 13g). A large projectile point with convex lateral edges. Very deep and wide corner notches form an expanding stem and sharp shoulders. The basal edge is straight. Flaking is poor. The point is made on a plano-convex flake. The planar face is chipped only along the edges. The convex face is flaked overall. The lateral edges are retouched. Length ca. 60.0 to 55.0 mm, width 27.0 mm, thickness 5.5 mm; fossil wood. Large corner-notched points very similar to

this specimen are Late Middle Prehistoric Period in age on the Northwestern Plains (Mulloy 1958). This appears to be the first report of such specimens in this area.

**Expanding Stem, Sharp Shouldered, Indented Base** (one specimen, Plate 13h). Except for a notched base, this projectile point is identical to the preceding specimen. Length ca. 50.0 mm, width 27.5 mm, thickness 6.0 mm; chert.

**Miscellaneous** (two specimens). One is a badly shattered side-notched projectile point made of chalcedony. It is probably of the Blackwater Side-Notched type. The second is an apical section of an obsidian point.

**Knife** (one specimen, Plate 13i). A triangular fragment from a bifacially flaked and retouched knife. Its former shape and size cannot be determined. Length 28.0 mm, width 19.0 mm, thickness 8.0 mm; obsidian.

**End Scraper** (one specimen, Plate 13k). Apparently this is a multipurpose tool: a thin, trapezoidal flake with a high-angle scraping edge at the narrower end. Both lateral edges are unifacially retouched and show evidence of use as scrapers. The wider end is very thin and has two projections, one tiny and triangular and one large and rectangular. The smaller projection, apparently a graver, was formed by the chipping of two concavities into the edge. The larger appears fortuitous and unused. Length 36.0 mm, width 27.0 mm, thickness 5.0 mm; fossil wood.

**Side Scraper** (one specimen, Plate 13j). This is a thick, plano-convex flake with unifacially chipped scraping bits on two opposing edges. A part is missing but the scraper apparently was rectanguloid in outline. Both faces are unaltered except for the scraping edges. Length 40.0 mm, width 33.0 mm, thickness 11.0 mm; fossil wood. A small triangular fragment recorded as having been recovered from the next higher level, Culture Layer 17, fit this specimen.

**Graver** (one specimen, Plate 13o). A sharply curved, ovate flake with two small graver points projecting obliquely from one end. Both points have minute retouching and the ends are chipped from use. Both lateral edges are minutely but unevenly retouched. The flake is otherwise unaltered. Length 43.0 mm, width 21.0 mm, thickness 4.5 mm; chert.

**Modified Flakes** (three specimens, Plate 13l, m). Various shaped stone flakes with unifacial retouching along one or more edges. Two are thin and one is thick, being more like a small core rather than a flake. Length 43.0 to 32.0 mm, width 30.0 to 26.0 mm, thickness 16.0 to 4.0 mm; chert (two), fossil wood (one).

**Miscellaneous Stone** (three specimens). Two are small fragments of unifacially retouched implements and one is a small fragment of a bifacially chipped tool. All are 20.0 mm or less in greatest dimension; chert (two), chalcedony (one).

**Bone Needle** (one specimen, Plate 13n). A well-made, needle-like implement — but it lacks an eye. It is sharply pointed, round in cross section at the distal end, and flattened at the proximal end. The latter end is smoothed and rounded; however, it has a slight concavity at the center as if it had been broken across an eye and subsequently smoothed. It is possible that the specimen represents a broken needle in the process of repair. Length 35.0 mm, diameter 1.5 mm.

## CULTURE LAYER 17

### *Features*

**Fire Pit 36.** This pit was identical in form and content to Fire Pits 2–5 in Culture Layer 6. Length 40.0 cm, width 27.5, depth 6.25 cm.

**Fire Pit 37.** A large, shallow, basin-shaped fire pit similar to Fire Pit 3 in Culture Layer 16. Bone fragments and stone flakes were recovered from the fill. Length 165.0 cm, width 97.5 cm, depth 10.0 cm.

## *Artifacts*

### **Chipped Stone**

#### **Projectile Points**

**Pahaska Side-Notched** (seven specimens, Plate 14a–f). A medium-size to large point with straight to convex lateral edges and a straight to weakly concave base. The side notches are deep and wide. They may be oriented transversely or at a low angle toward the tip. Normally the notches tend to be parallel with the basal edge. Cross sections are biconvex. Flaking ranges from poor to excellent with a majority exhibiting fair to good workmanship. Lateral edges are retouched. Bases are bifacially thinned. The basal edges are lightly ground. Length 45.0 to 26.0 mm, width 23.0 to 18.5 mm, thickness 6.5 to 4.0 mm; chert (five), chalcedony (one), fossil wood (one). Initially I hesitated to introduce a new name for a projectile point type with two previously assigned designators. However, in consideration of the stratigraphic separation of two genetically related types of points in Mummy Cave and objections to both of the earlier descriptions, it was decided that new type descriptions and names would be more meaningful to others working in the central Rocky Mountain region.

Agogino (1962:247) proposed that these early side-notched points be named Simonsen points with the qualification that if slight variation with points from the Simonsen site occurred, a combination of site names be used with Simonsen as the precedent. The type description (Agogino and Frankforter 1960:415) is based on a small number of specimens from the Simonsen site and most of these are broken. At least two types are represented (Mason 1962:Figure 3). The Mummy Cave sequence demonstrates temporal priority of one type, the Blackwater Side-Notched category. In Agogino and Frankforter's description both are included within one type. Therefore, it is possible that use of this type name could mask temporal differences in future site reports. Such a situation has already occurred.

Numerous sites in Idaho have produced side-notched points obviously identical or closely related to those from Simonsen and Mummy Cave (Butler 1962; Swanson and Sneed 1966; Lynch and Olsen 1964; Swanson, Butler, and Bonnichsen 1964). In Idaho these are named Bitterroot points and are diagnostic of the Bitterroot phase purported to have begun by about 6500 to 6000 BC (Swanson and Sneed 1966:25) and to have lasted until about 1000 BC (Swanson, Butler, and Bonnichsen 1964:116). The problem here is that throughout the Bitterroot phase, lasting some 5,000 years, all side-notched points are called Bitterroot. Not all are like the Simonsen and Mummy Cave types, and changes in point form through time are indicated. Hence, the name Bitterroot has little or no utility for comparative purposes.

**Miscellaneous** (two specimens). Apical sections made on petrified wood. One is very well flaked; the other is mediocre.

#### **Knives**

**Crude Ovate** (one specimen, Plate 14h). A roughly and bifacially flaked knife with bifacial retouching along one lateral edge. The cross section is unevenly biconvex. The tip is missing. Length ca. 50.0 to 45.0 mm (estimated), width 26.0 mm, thickness 8.0 mm; fossil wood.

**Plate Chalcedony Knife** (one specimen, Plate 14n). A trapezoidal piece of thin plate chalcedony neatly and bifacially retouched along one lateral edge. The edge is slightly dulled from use. Length 36.0 mm, width 34.0 mm, thickness 4.0 mm.

**Side Scrapers** (two specimens, Plate 14g, l). One is a longitudinally curved, ovate flake with well-executed unifacial chipping along one lateral edge. The narrower end is bifacially chipped and appears to have been used as a chisel. Length 42.0 mm, width 25.0 mm, thickness 5.0 mm; fossil wood. The second is the small triangular fragment that fit the side scraper found in Culture Layer 16.

**Ovate Biface** (one specimen, Plate 14i). A small, crude, bifacially chipped implement with sinuous edges. The edges are not retouched but bear minute use flake scars. It is unevenly biconvex in cross section. Length 41.0 mm, width 38.0 mm, thickness 13.0 mm; fossil wood.

**Graver** (one specimen, Plate 14m). A triangular fragment of a blade-like flake with unifacial chipping along one edge and a worn chipped point. The flake is triangular in cross section. Length 25.0 mm, width 18.0 mm, thickness 5.0 mm; obsidian.

**Modified Flakes** (two specimens, Plate 14j, k). One is a large rectanguloid flake with some discontinuous unifacial chipping on the longer edge. This edge also exhibits use flake scars. Length 66.0 mm, width 44.0 mm, thickness 12.0 mm; chert.

The other is a thin lanceolate flake or blade with use flake scars along the convex edge. It shows no evidence of intentional retouching. Length 42.0 mm, width 18.0 mm, thickness 4.0 mm; obsidian.

**Core** (one specimen). This is a small faceted piece of stone with a pentagonal cross section. It appears to be an exhausted core. Length 45.0 mm, width 33.0 mm, thickness 26.0 mm; fossil wood.

## CULTURE LAYER 18

### *Features*

**Fire Pit 38.** This is another example of the shallow, oval, basin-shaped fire pit found in a number of the underlying culture layers. Its contents were ash, charcoal-stained earth, and charcoal flecks. Length 57.5 cm, width 45.0 cm, depth 10.0cm.

**Fire Pits 39 and 40.** Identical to the large shallow fire pits with stratified fill found in Culture Layers 16 and 17. Fire Pit 39 contained an antler tip and several small obsidian flakes. A Pahaska Side-Notched projectile point, a few stone flakes, and bone fragments were recovered from the fill of Fire Pit 40. Fire Pit 39 was 135.0 cm long, 97.5 cm wide, 10.0 cm deep. Fire Pit 40 was 145.0 cm long, 125.0 cm wide, 10.0 cm deep.

### *Artifacts*

#### **Chipped Stone**

##### **Projectile Points**

**Pahaska Side-Notched** (17 specimens, Plate 15a–m). These projectile points are identical to those from Culture Layer 17. They constitute additional examples of the type. Length 55.0 to 27.0 mm, width 28.0 to 14.0 mm, thickness 5.0 to 4.0 mm; chert (15), fossil wood (one), obsidian (one).

**Miscellaneous** (two specimens). Two apical projectile point fragments; chalcedony and petrified wood.

**Knife** (one specimen, Plate 15q). One end of a knife made on a large plano-convex flake. The dorsal surface has overall percussion flaking but the ventral surface is unaltered except for peripheral retouching. The edges of the dorsal surface also are retouched. Apparently the knife was ovate or elliptical in form. Length 45.0 mm, width 34.0 mm, thickness 14.0 mm; obsidian.

##### **Scrapers**

**Crude End Scrapers** (two specimens, Plate 15r, v). One scraper is made on a rectanguloid flake triangular in cross section. One end has a high-angle scraping edge unifacially chipped on the dorsal surface. Both lateral edges are haphazardly retouched. The ventral surface contains a prominent bulb of percussion at the proximal end and is unaltered. Length 37.0 mm, width 30.0 mm, thickness 10.0 mm; quartzite.

The other scraper specimen is made on a pentagonal flake concavo-convex in longitudinal section. It is triangular in cross section. One end and an adjacent side have finely flaked scraping edges. The opposite end is retouched and has a blunt graver tip at one corner. The remaining two edges are roughly retouched. The concave ventral surface is unaltered. Length 40.0 mm, width 27.0 mm, thickness 10.0 mm; fossil wood.

**Serrate Scraper?** (one specimen, Plate 15o). A broken side-notched projectile point with a steep, unifacially flaked, serrate scraping edge along one side. Three concavities were chipped into the edge to form three blunt projections the tips of which are somewhat worn. The edge beyond the most distal of the projections is beveled toward the opposite lateral edge. The sides of the base below the side notches are missing. Length 30.0 mm, width 18.0 mm, thickness 5.0 mm; chert.

**Flake Scraper** (one specimen, Plate 15s). A curved rectangular flake with steep, well-executed, unifacial flaking along one lateral edge. The remainder of the periphery is roughly retouched. The narrower end bears many minute use flake scars. Length 34.0 mm, width 20.0 mm, thickness 3.5 mm; chert.

**Biface** (one specimen, Plate 15p). A circular bifacially percussion flaked implement with rough sinuous edges. There is no retouching but use flake scars are visible along the periphery. It is thick and biconvex in cross section. Length 48.0 mm, width 46.0 mm, thickness 22.0 mm; fossil wood.

**Modified Flake** (one specimen, Plate 15n). A trianguloid flake with roughly applied unifacial retouch along most of the concave edge. It is otherwise unaltered. Length 47.0 mm, width 25.0 mm, thickness 7.0 mm; fossil wood.

### **Rough Stone**

**Hematite** (one specimen). A small triangular piece of hematite-bearing stone probably used for pigment. Length 23.0 mm.

### **Bone**

**Splinter Flaker?** (one specimen, Plate 15u). A splinter of mammal long bone with a small minutely scarred and blunted tip. One lateral edge is dulled and scarred for a distance of 25.0 mm beginning 10.0 mm below the working tip. Length 81.0 mm, width 12.0 mm, thickness 5.0 mm.

**Flaker Tip** (one specimen, Plate 15t). The tip of an antler tine. It is severely weathered but the tip appears to be worn and the sides appear to be scarred. Length 43.0 mm.

## **CULTURE LAYER 19**

### *Features*

**Fire Pit 41.** A small, shallow, oval, basin-shaped depression containing charcoal-stained earth. 42.5 cm long, 32.5 cm wide, 3.75 cm deep.

**Fire Pit 42.** A roughly oval area of burned earth overlain by ash and scattered charcoal. It was the remains of a surface fire. 55.0 cm long, 45.0 cm wide, 2.5 cm. thick.

### *Artifacts*

#### **Chipped Stone**

**Pahaska Side-Notched** (one specimen, Plate 26l). This specimen is typical of this projectile point type. The distal half is missing. Length 45.0 mm (estimated), width 21.5 mm, thickness 5.5 mm.

#### **Bone**

**Flaker Tip** (one specimen). A piece of smoothed and polished bone triangular in cross section with a blunt smoothed tip exhibiting minute scarring. It appears to have been a knapping tool. Length 22.0 mm, thickness 5.0 mm.

#### **Shell**

**Shell Fragment** (one specimen). A small thin piece of unidentified shell. It does not appear to be purposely altered. Length 20.0 mm, width 7.0 mm, thickness 1.0 mm.



## CULTURE LAYER 20

### Bone

**Cut Bone** (one specimen). A piece of split mammal long bone with several parallel longitudinal cut marks near one end.

## CULTURE LAYER 21

### Feature

**Fire Pit 43.** A small, shallow, circular, basin-shaped fire pit containing ash and scattered charcoal. The bottom consisted of burned earth. 45.0 cm diameter, 7.5 cm deep.

### Artifacts

#### Chipped Stone

**Eared, Notched Base** (one specimen, Plate 26m). A medium-size projectile point with straight lateral edges and a deeply indented base. Deep, wide side notches are oriented parallel to the basal edge. The sharply expanding stem has rounded tips. The point is biconvex in cross section. Chipping is moderately well controlled, and the lateral edges are retouched. The tip and one basal ear are missing. Length 39.0 mm (estimated), width 22.0 mm (estimated), thickness 5.0 mm; chalcedony.

## CULTURE LAYER 22

### Artifacts

#### Chipped Stone

**Modified Flake** (one specimen, Plate 26k). A thin, rectanguloid flake with minute retouching along both lateral edges and one end. Length 32.0 mm, width 19.0 mm, thickness 4.0 mm; chert.

## CULTURE LAYER 23

### Features

**Fire Pits 44 and 45.** Shallow, oval, basin-shaped fire pits filled with ash, charcoal-stained earth, and bits of charcoal. Fragments of bone were found in each, and Fire Pit 45 contained a few stone chips. Fire Pit 44 - 47.5 cm long, 42.5 cm wide, 5.0 cm deep. Fire Pit 45 was 80.0 cm long, 72.0 cm wide, 2.5 cm deep.

**Fire Pit 46.** A small oval area of burned earth, ash, and charcoal representing a surface fire. 37.5 cm long, 32.5 cm wide, 2.0 cm thick.

## CULTURE LAYER 24

### Features

**Fire Pits.** Prior to the 1966 excavations, fire pit data were not recorded in detail. Consequently, the single fire pit located in 1966 is the only one for which there is complete information. Nine fire pits are recorded in the profiles for the culture layer. Maximum diameters and depths cannot be ascertained.

**Fire Pit 47.** A shallow, oval, basin-shaped fire pit filled with ash and flecks of charcoal. 90.0 cm long, 65.0 cm wide, 7.5 cm deep.

**Fire Pits 48–56.** All appear similar to the above fire pit. The profiles indicate basin-shaped pits of various depths containing ash and scattered charcoal. Assuming diameters and depths indicated in the

profiles to be maximums, diameters ranged from 75.0 to 42.5 cm and depths from 20.0 to 7.5 cm. Some were probably larger.

**Fire Pit 57.** A very large and shallow fire pit or fire area is described in the notes. It covered most of one five-foot square and extended into another. It contained a few stones, ash, and charcoal. The fire area was at least 180.0 cm long and 105.0 cm wide.

## *Artifacts*

### **Chipped Stone**

#### **Projectile Points**

**Stemmed, Straight to Concave Base** (six specimens, Plate 16a–e). Projectile points variable in stem form and workmanship. They have convex lateral edges, prominent shoulders, and moderately to sharply expanding stems. Three exhibit weakly concave bases with rounded corners. Two have straight bases with sharp corners. Cross sections range from biconvex to plano-convex. Chipping varies from good to mediocre. Length 41.0 to 33.0 mm, width 23.0 to 19.5 mm, thickness 6.5 to 5.0 mm; chert (four), chalcedony (one), fossil wood (one). Some of these are very similar to points from Culture Layers 28 and 30 described below. However, as a group, differences are great enough to form a separate category.

**Shallow Side-Notched, Straight Base** (four specimens, Plate 16f, g). Triangular in outline with straight to convex lateral edges and straight bases. The side notches are wide and shallow and placed 4.0 to 5.0 mm above the base. Cross sections are lenticular. Chipping ranges from poor to excellent. Lateral edges are retouched and one specimen is serrated. All are broken. Length undetermined, width 21.0 to 17.0 mm, thickness 5.0 to 4.5 mm; chalcedony (two), chert (two). These are reminiscent of the side-notched points from Layers 16 to 18; however, the notches are considerably shallower, the bases are more commonly straight, and size seems more variable.

**Miscellaneous** (six specimens). One is a nearly complete projectile point, but the extreme proximal portion is missing (Plate 16h). It appears to be one of the stemmed, straight to concave base category. It has weakly convex lateral edges and prominent shoulders. It is moderately well flaked and is biconvex in cross section. The specimen is estimated to have been 53.0 mm long. It is 20.0 mm wide and 6.0 mm thick. It is made of chert.

Three are apical fragments of chalcedony and two specimens are lateral fragments; one of obsidian and one of chert.

#### **Knives**

**Small Triangular** (one specimen, Plate 16i). A thin, triangular knife with a straight base. The lateral edges are weakly convex. Flaking is very rough and retouching is haphazard. The edges are ragged and sinuous. The cross section is biconvex. Length 33.0 mm, width 28.0 mm (estimated), thickness 4.0 mm; chert.

**Miscellaneous** (two specimens). Two apical fragments of knives. One is flaked overall and the edges are retouched. The other is flaked only along the edges. Both are less than 30.0 mm long; chert (two).

**Blades** (three specimens, Plate 17j, k). Prismatic flakes utilized as cutting and/or scraping tools. One has minute retouching along both edges and two are retouched on one edge. Use flake scars are visible on both. Length 70.0 to 32.0 mm, width 20.0 to 10.5 mm, thickness 7.0 to 2.5 mm; chert (two), chalcedony (one).

#### **Scrapers**

**Side Scrapers** (two specimens, Plate 16k). One is a large, thick, trapezoidal flake with well-controlled, unifacial, high-angle flaking on the longer edge. The working edge is thin and is opposite the bulb of percussion on the ventral surface. The dorsal surface bears a few flake scars but consists mainly of pebble cortex. Length 58.0 mm, width 44.0 mm, thickness 18.0 mm; petrified wood.

The other is a small, ovate flake with a roughly chipped scraping edge along one side. The flake is lozenge-shaped in cross section. The dorsal and ventral surfaces meet at a roughly 60° angle at the scraping edge. This edge is slightly dulled and polished from use. Length 28.0 mm, width 18.0 mm, thickness 7.0 mm; chert.

**Concave Scraper** (one specimen). A thick, trapezoidal flake with a shallow, concave, roughly flaked scraping edge near the center of one side. The flake is otherwise unaltered. It is roughly plano-convex in cross section. Length 58.0 mm, width 36.0 mm, thickness 14.0 mm; chert.

**Flake Scraper** (one specimen, Plate 17i). An irregularly shaped flake with two rectangular projections separated by a concave edge. The dorsal surface bears several large flake scars but the ventral surface is flat. The ends of both projections are unifacially retouched on the dorsal surface. Retouching extends from one projection along an irregular edge that has a small graver. The concave edge between the projections is retouched on the ventral surface. Length 30.0 mm, width 24.0 mm, thickness 5.0 mm; obsidian.

**Modified Flakes** (four specimens, Plate 16j and Plate 17i, m). Various shaped flakes with intentional retouching along one edge. They are otherwise unaltered. Length 53.0 to 26.0 mm, width 33.0 to 13.0 mm, thickness 12.0 to 5.0 mm; chert (two), fossil wood (one), quartzite (one).

**Utilized Flakes** (four specimens, Plate 16i). Various shaped flakes with one or two naturally sharp edges. These edges contain minute irregular flake scars caused by use in cutting or scraping. Length 46.0 to 22.0 mm, width 24.0 to 17.0 mm, thickness 9.0 to 3.0 mm; chalcedony (two), fossil wood (two).

**Miscellaneous** (two specimens). Two small fragments bearing pressure flaking. Their function and former shape are undetermined. Both are less than 30.0 mm in length; chalcedony (two).

## **Bone**

### **Awls**

**Metatarsal Awl** (one specimen, Plate 17a). Made from a piece of bone split from the proximal end of a metatarsal, probably of mountain sheep. A small portion of the articular surface remains. The tip is oval in cross section, sharp, and well polished. Sharp edges have been rounded and smoothed but the proximal end is unaltered. Length 126.0 mm, width 14.0 mm.

**Eyed Awl** (one specimen, Plate 17h). A badly broken but well-made awl with an eye at the proximal end. It could have been used as a needle, but its large size is more suggestive of an awl. It is oval in cross section. The sides are parallel at the proximal end and taper gradually to a narrow, sharp point. The implement is broken through the eye that is about 2.0 mm in diameter. All surfaces are highly polished. Length more than 130.0 mm, width 6.0 mm, thickness 4.0 mm.

**Splinter Awl** (one specimen, Plate 17f). A small splinter of bone with smoothed edges and a tapering sharp point. Although small, it may be complete, or if broken, the rough proximal end was smoothed after breaking. Length 36.0 mm, width 4.5 mm.

**Flaker** (one specimen, Plate 17b). A piece of split mammal long bone with one rounded and smoothed end that is pitted and scarred. The remainder is unaltered. Length 87.0 mm, width 15.0 mm.

**Tube** (one specimen, Plate 17g). A section of wing bone from a large bird, possibly eagle. The ends are rounded and smoothed. There are five rows of short, parallel, transverse, incised lines extending longitudinally from one end for a distance of about 40.0 mm. Length 73.0 mm, width 10.0 mm, thickness 7.5 mm.

### **Beads**

**Mammal Rib Bead** (one specimen, Plate 17c). A section of rib from a small mammal. The surface has longitudinal striations caused by smoothing. The cut ends are roughly smoothed. Length 37.0 mm, width 6.0 mm, thickness 3.5 mm.

**Tubular Beads?** (two specimens, Plate 17d, e). One is a section of bird bone broken at both ends. It may or may not have been a bead. The other is a short section of badly weathered mammal bone with a hole through it. Both ends are broken but the central hole appears to be man made. Length 26.0 and 26.0 mm, thickness 6.0 and 3.0 mm, respectively.

**Cut Bone** (two specimens). A splinter of mammal long bone and part of a mammal pelvis have random light cutting marks.

**Smoothed Bone** (one specimen). A small, rectanguloid piece of bone. It appears to have been smoothed during passage through a human or animal alimentary tract. Length 22.0 mm, width 10.0 mm.

## CULTURE LAYER 25

### *Artifact*

#### **Chipped Stone**

##### **Projectile Point**

**Large Side-Notched, Straight Base** (one specimen, Plate 26n). A large projectile point with smoothly convex lateral edges and a straight base. The side notches are deep and wide. They are placed 4.0 mm above the base and are oriented at a low angle toward the tip. The cross section is smoothly biconvex and chipping is excellent. All edges are retouched. The basal edge is ground smooth. Length 45.0 mm, width 24.0 mm, thickness 5.0 mm; chert. Again, this specimen is reminiscent of those in Culture Layers 16 to 18. It is comparable in size, but the notches are more obviously pointed toward the tip and do not parallel the basal edge as nearly as those in the lower layers.

## CULTURE LAYER 28

### *Description*

Difficulty was encountered in the identification and excavation of this stratum. Some mixture of artifacts is noted between this layer and Culture Layer 30 above — it appears that the excavators were unable to separate Layers 28 and 30 during some periods of excavation. In the profiles (Figures 2 and 3) Layer 28 is shown as a single stratum with Layers 27 and 29 below and above. As far as I have been able to determine, these three probably constituted one thick occupational level similar to Layers 30 and 36. A few artifacts were labeled as having come from Layers 28A and 26B (previously designated Layers 8A and 8B); however, this separation into sub-levels was not continued indicating that one occupation stratum was represented. The extent of Layers 27 and 29 indicated in the profiles suggests that substantial occupations were involved and that a considerable number of artifacts should have been present in each.

The large number of artifacts assigned to Layer 28 and the variety of projectile point styles present suggests either an intensive occupation over an extended period or the presence of two or more individual strata with little or no vertical separation. If the latter instance obtains, little violence is done to interpretation because Layer 28, whatever its constitution, can be isolated to a fairly narrow span of time and certain diagnostic artifacts can be isolated to this interval.

### *Features*

**Fire Pits 58–65.** Eight fire pits were recorded in the profiles and site notes. Apparently, Fire Pits 58–63 were circular to oval, basin-shaped pits filled with ash and charcoal. Fire Pits 58, 59, and 60 contained a few rocks or fragments. Fire Pits 64 and 65 were considerably larger than the others but their dimensions and depths are unknown. They contained ashy soil and scattered charcoal.

## *Artifacts*

### **Chipped Stone**

#### **Projectile Points**

**Laterally Notched, Indented Base** (15 specimens, Plate 18a–h). This category contains projectile points ranging from small to large. Lateral edges range from straight to convex and bases range from smoothly concave to notched. The side notches are generally wide and shallow and are placed at least 5.0 mm above the base. Most are widest above the notches, but a few are widest at the base. Cross sections are biconvex. Chipping ranges from mediocre to good. The basal edge and lateral edges below the notches are lightly ground. Length 53.0 to 35.0 mm, width 25.0 to 17.0 mm, thickness 7.0 to 4.0 mm; chalcedony (six), chert (five), fossil wood (three), quartzite (one).

This group manifests traits similar to the side-notched points from Culture Layers 16–18. However, they closely resemble another category from the present layer and Culture Layer 30. Apparently they represent a transitional form and their significance will be discussed in a following section.

An apical section recorded as having been found in Culture Layer 30 fit the basal portion of one of these specimens indicating mixture between layers. Culture Layers 28 and 30 converged in the north-central part of the shelter and some fire pits in Culture Layer 30 penetrated Culture Layer 28.

**Eared, Indented Base** (15 specimens, Plate 18i–q, s). This group is similar to the laterally notched, indented base category. Lateral edges are straight to convex and bases range from smoothly concave to notched. The side notches are placed lower on the edge than in the laterally notched, indented base group. The notching forms obliquely oriented ears with rounded ends. Cross sections are lenticular. Flaking ranges from poor to excellent with a majority exhibiting mediocre workmanship. Length 41.0 to 23.0 mm, width 21.0 to 12.0 mm, thickness 7.0 to 4.0 mm. One is much smaller and cruder than the others. It may be a child's toy. It measures 14.0 mm in length, 10.0 mm in width, and 2.5 mm in thickness; chalcedony (seven), chert (four), fossil wood (three), obsidian (one). The distal portion of one specimen is recorded as having been found in Culture Layer 30.

**Crude, Triangular, Straight Base** (one specimen). A poorly made specimen with straight lateral edges and base. The distal half is missing. Chipping is very poor but the edges are retouched. The cross section is biconvex. Length undetermined, width 20.5 mm, thickness 4.0 mm; chalcedony.

**Triangular, Convex Base** (one specimen, Plate 19f). A somewhat crude point with weakly convex lateral edges and slightly convex base. The basal corners are rounded. Chipping is poor and covers only a portion of one face. The cross section is biconvex. Length 31.0 mm, width 16.5 mm, thickness 4.5 mm; chert.

**Trianguloid Flake Points** (two specimens). Crudely made points with straight lateral edges and bases. The base of one is oblique. Flaking is very poor and limited to the peripheries of both faces. Cross Sections are biconvex. Length 26.0 and 25.0 mm, width 13.0 and 11.0 mm, thickness 3.5 and 3.5 mm; chalcedony (one), chert (one).

**Side-Notched, Concave Base** (one specimen, Plate 19d). A well-made point with smoothly convex lateral edges and a shallow concave base. The deep and wide side notches are placed parallel with the basal edge. The basal ears are rounded. Flaking is very good, and all edges are retouched. Length 30.0 mm, width 20.0 mm, thickness 5.0 mm; chert.

**Large Corner-Notched, Convex Base** (three specimens, Plate 19a, h, 1). Large points with convex lateral edges and weakly convex bases. The deep, wide corner notches are oriented at a moderate angle toward the tip. Flaking is mediocre but the lateral edges are retouched. Two cross sections are biconvex and the other is concavo-convex. Two are broken. Length 64.0 to 30.0 mm, width 28.5 to 25.0 mm (estimated), thickness 6.0 to 5.0 mm; chert (two), fossil wood (one).

**Small Side-Notched, Convex Base** (four specimens, Plate 19b, c). These have straight to slightly convex lateral edges and convex bases. Deep, wide side notches placed obliquely form expanding stems. Flaking is fair and edges are retouched. Cross sections are biconvex. The basal edge of one is lightly ground. Length 30.0 to 26.0 mm, width 24.0 to 17.0 mm, thickness 5.0 to 4.0 mm; chert (two), fossil wood (one), obsidian (one).

**Rectangular Stem** (two specimens, Plate 18t). These specimens have weakly convex edges and parallel-edged stems with straight bases. Shoulders are prominent and range from straight to barbed. Chipping is mediocre. Cross sections are biconvex. The larger specimen is broken and the broken edge is uniaxially flaked to form a scraper or chisel. The opposite face bears many use flake scars. Length 30.0 (estimated) and 24.0 mm, width 16.0 (estimated) and 24.0 mm, thickness 5.0 and 5.5 mm, respectively; chalcedony (one), chert (one).

**Expanding Stem, Concave Base** (one specimen, Plate 19e). A crudely fashioned point with straight lateral edges. Deep, extremely wide side notches form an expanding stem with sharply convex base. Chipping is poor and there is no edge retouch. The cross section is thick and biconvex. The stem edges are smoothed. Length 38.0 mm, width 17.0 mm, thickness 7.0 mm; chert.

**Short Stem, Indented Base** (two specimens, Plate 18r). The distal portions of both specimens are missing. The lateral edges probably were convex. Shoulders are prominent. The stems are expanding and have shallowly indented bases. Cross sections are biconvex. Chipping is mediocre but the lateral edges are retouched. One specimen is serrated. The edges of the stem of the other specimen are lightly ground. Length undetermined, width 20.0 and 16.0 mm, thickness 5.0 and 5.5 mm, respectively; chalcedony (one), chert (one).

**McKean Lanceolate** (one specimen, Plate 19g). An extremely short heavily reworked example of the type. The lateral edges are convex but one is angled. The specimen is nearly pentagonal in outline. The base is deeply notched. Chipping is moderately well controlled and the edges are retouched. The cross section is biconvex. Length 17.5 mm, width 14.0 mm, thickness 5.0 mm; fossil wood.

**Miscellaneous** (20 specimens). Thirteen apical fragments and seven medial fragments of small to large points. None are identifiable as to type or form. A midsection fitting one of the apical fragments is recorded as having been recovered from Culture Layer 30; chert (ten), chalcedony (six), fossil wood (three), quartzite (one).

## Knives

**Side-Notched, Convex Base** (two specimens, Plate 20a, b). Roughly made triangular knives with weakly convex lateral edges and deep, wide side notches placed near the base. The base is convex. The side notches are placed transversely on one specimen while the other has one transverse notch and one oriented obliquely toward the distal end. Notching forms sharply expanding stems. Chipping is poorly controlled but the lateral edges are finely retouched. The convex edge of the complete specimen is slightly dulled from use. One specimen is represented only by the basal portion but is considerably larger than the complete knife. Length undetermined and 86.0 mm, width 48.0 and 37.0 mm, thickness 10.0 and 7.0 mm, respectively; chalcedony (one), fossil wood (one).

**Trianguloid, Concave Base** (one specimen, Plate 20d). An asymmetric knife having one convex edge and one slightly concave edge. The base is angularly concave. It is widest a short distance from the base and the basal corners are rounded. Chipping is moderately well controlled. The base is longitudinally thinned and the lateral edges are finely retouched. The cross section is unevenly biconvex. Length 55.0 mm, width 33.0 mm, thickness 9.0 mm; chalcedony.

**Elliptical** (one specimen, Plate 20e). The specimen has convex lateral edges and is rounded at both ends. One end is narrower than the opposite end. Both faces are flaked overall and both ends are thinned. One lateral edge is bifacially retouched and lightly dulled from use. The cross section is plano-convex. Length 54.0 mm, width 32.0 mm, thickness 11.0 mm; chert.

**Discoidal** (two specimens, Plate 20c, o). Nearly circular knives made of thin pieces of stone with bifacial flaking on all or nearly all of the peripheries. One is small and chipped along its entire periphery. It is made on plate chalcedony and retains the cortex at the center of each face. It is much better made than the other specimen. The periphery of the larger has two thick areas that are not flaked. It is generally rougher than the smaller knife. The edges of both are dulled from use. Length 58.0 and 37.0 mm, width 52.0 and 33.0 mm, thickness 12.0 and 8.0 mm, respectively; chalcedony (one), fossil wood (one).

**Plate Chalcedony Knife** (one specimen, Plate 20j). A small, rectanguloid piece of plate chalcedony with fine bifacial flaking and retouching along one slightly convex edge. The stone is otherwise unaltered. Length 37.0 mm, width 20.0 mm, thickness 5.0 mm.

**Ovate** (two specimens, Plate 21e, i). The basal portions of two crudely made ovate knives. Chipping is limited mainly to the edges that are roughly retouched. One is plano-convex in cross section and the other is unevenly biconvex in cross section. Length 75.0 mm (estimated) and 45.0 mm (estimated), width 38.0 and 21.0 mm, thickness 10.5 and 6.0 mm, respectively; chert (one), fossil wood (one).

**Flake Knife** (one specimen, Plate 20i). A large, thick, rectanguloid flake with a thin convex edge at one end. Apparently a few large flakes were removed to form the sharp edge. Another flake or flakes were removed from the same edge forming a handle-like projection. The sharp edge was used without alteration but it does exhibit use flake scars. Length 108.0 mm, width 47.0 mm, thickness 21.0 mm; fossil wood.

**Proximal Fragments** (four specimens, Plate 20f, g). Specimens with straight to slightly convex lateral edges and straight bases. They are flaked overall and retouched along the lateral edges. The cross sections are biconvex. Length 85.0 (estimated) to 45.0 mm (estimated), width 34.0 to 23.0 mm, thickness 11.0 to 5.5 mm; chert (three), chalcedony (one).

**Distal Fragments** (four specimens). Two are large and thick apical sections with convex lateral edges. When complete they probably were oval in shape. Both faces are flaked overall and the sinuous edges are retouched. Cross sections are biconvex. Length 41.0 and 40.0 mm, width 39.0 and 36.0 mm, thickness 9.0 and 10.0 mm, respectively; chert (one), quartzite (one).

Another is similar to the above but smaller and thinner. Length 30.0 mm, width 26.0 mm, thickness 6.0 mm; chert.

The fourth is thick and narrow. From a dull, rounded tip the edges diverge at a low angle to the point of breakage. Both faces are flaked overall; the edges are retouched; the cross section is biconvex. The tip appears to have been used as a gouge. Length 34.0 mm, width 25.0 mm, thickness 9.0 mm; chalcedony.

### Scrapers

**Stemmed** (one specimen, Plate 21f). An end scraper with a long, concave-edged stem with convex base. It has an asymmetric semicircular bit. The stem edges contract from the widest point and then expand to the base. The scraper is plano-convex in cross section and concavo-convex in longitudinal section. The convex dorsal surface is flaked overall and the edges are evenly retouched. The ventral surface is unaltered. Length 45.0 mm, width 23.0 mm, thickness 6.0 mm; fossil wood.

**Large Discoidal** (two specimens, Plate 20m, n). Large, ovate to circular, plano-convex scrapers with high-angle working edges along one-third to one-half of the periphery. The remainder is roughly retouched. Dorsal surfaces bear large percussion flake scars. One is thinned at the proximal end of the ventral surface. The other is unaltered. Length 59.0 and 55.0 mm, width 50.0 and 53.0 mm, thickness 13.0 and 14.0 mm, respectively; chert (two).

**Small Discoidal** (two specimens, Plate 21b, c). Although smaller, these are identical to the above two discoidal scrapers. Length 35.0 and 35.0 mm, width 31.0 and 30.0 mm, thickness 9.0 and 9.0 mm, respectively; chalcedony (one), chert (one).

**Oval End Scraper** (one specimen, Plate 21a). A high-angle end scraper made on a large, oval, plano-convex flake. The end bearing the scraping edge is thicker and considerably narrower than the other end. The scraping edge is semicircular and finely flaked. Flaking extends along both lateral edges about half way toward the proximal end. There is some haphazard unifacial chipping of the latter end. The dorsal surface consists mainly of weathered cortex. Length 57.0 mm, width 37.0 mm, thickness 12.0 mm; chert.

**Ovate End Scraper** (one specimen, Plate 21o). A twisted ovate flake with a high-angle, unifacially flaked scraping edge at the wider end. The bit is chipped and scarred from use. Both lateral edges converge to a point at the proximal end. They are unifacially retouched and bear evidence of use in scraping. The scraper is plano-convex in cross section and concavo-convex in longitudinal section. Length 37.0 mm, width 22.0 mm, thickness 5.0 mm; chalcedony.

**Flake End Scraper** (one specimen). A thin, pentagonal flake with a high-angle scraper chipped along one edge. The bulb of percussion forms a thickening at the end bearing the scraping edge and is on the dorsal surface. One edge adjacent to the bit is unifacially retouched. Length 31.0 mm, width 28.0 mm, thickness 5.0 mm; chert.

**Concave Scraper** (one specimen, Plate 21d). A roughly ovate flake with a unifacially chipped semi-circular scraping edge on one side. The concave bit is finely flaked. Flaking extends from the bit to the convex edge at one end of the flake. Length 42.0 mm, width 29.0 mm, thickness 6.0 mm; fossil wood.

**Miscellaneous** (three specimens). Thick fragments of broken artifacts with unifacial flaking along an edge. Apparently they are parts of broken end or side scrapers. The former shapes and sizes cannot be determined; chalcedony (one), chert (one), fossil wood (one).

**Spokeshave?** (one specimen, Plate 20k). A thick, bifacially chipped implement with one convex and one concave lateral edge. One end is straight, while the other forms an obtuse angle with the apex at the center of the edge. The convex edge is sinuous and bears a few scattered use flake scars. The concave edge bears a few scattered use flake scars and is slightly dull. The ridges between flake scars on one face are dulled and one large nearly planar flake scar bears small dulled areas. A few of the ridges on the opposite face are dulled. The dulling must have occurred after the tool was made, possibly by hafting, because not all ridges are altered. Length 67.0 mm, width 37.0 mm, thickness 16.0 mm; pitchstone.

**Modified Blades** (six specimens, Plate 21j–l). Prismatic blades of various sizes with intentional unifacial retouching along both lateral edges. Retouching is more even and extensive on one edge than on the other. The largest has one slightly concave edge roughly chipped and scarred from use. Three of the smaller blades appear to have flaked striking platforms. Three others have dulled platforms apparently formed by lightly tapping the core numerous times with a hammerstone. Five are triangular and one is trapezoidal in cross section. Length 60.0 to 27.0 mm, width 22.0 to 13.0 mm, thickness 9.5 to 3.0 mm; chalcedony (two), chert (two), obsidian (two).

## Drills

**T-Shaped** (one specimen, Plate 19m). The shaft and the tip of one arm of the base are missing. It is bifacially flaked and the shaft is lozenge-shaped in cross section. The base is plano-convex in cross section and the basal edge is unifacially retouched and slightly dull. Length undetermined, width 30.0 mm (estimated), thickness 5.5 mm; chert.

**Expanded Base** (two specimens, Plate 19i, k). The shafts of both are broken. One has a convex base. From the basal edge the lateral edges converge to meet the shaft. The other has a base with nearly parallel lateral edges that converge at a sharp angle to meet the shaft from a point about 15.0 mm below the basal edge. Both are bifacially flaked and retouched. The bases are biconvex in cross section. Lengths undetermined, width 18.0 and 18.0 mm, thickness 7.0 and 6.0 mm, respectively; chalcedony (two).

**Drill Shaft** (one specimen, Plate 19j). The shaft of a bifacially chipped drill, oval in cross section. The edges are severely chipped and crushed from use. Length 28.0 mm, width 8.5 mm, thickness 6.0 mm; chalcedony.



**Blanks** (four specimens, Plate 20h). Bifacially percussion flaked ovate objects with sinuous edges. There is no edge retouching and they appear to be blanks. Two are complete and two are broken. Length 61.0 to 39.0 mm, width 38.0 to 22.0 mm, thickness 10.0 to 5.0 mm; chert (four)

### **Gravers**

**Semilunate** (three specimens, Plate 21g, h). Flakes or blades with straight bases. Two have unifacial chipping along the concave edge and one is chipped along both edges. The pointed ends are graver tips that are scarred from use. The tip is missing on one but its overall form suggests it is the same type of tool as the other two. All are triangular in cross section. Length 46.0 to 41.0 mm, width 22.0 to 20.0 mm, thickness 12.0 to 5.5 mm; chalcedony (one), obsidian (one), fossil wood (one).

**Piriform** (one specimen, Plate 19n). A flake with fine unifacial retouching around the entire periphery. There is a short section of retouching near the tip on the opposite face. The tip is scarred and slightly blunted from use. Length 29.0 mm, width 16.0 mm, thickness 5.0 mm; chert.

**Flake Graver** (one specimen, Plate 21n). A thick rectanguloid flake with a fortuitous triangular graver point extending laterally from one end. In addition, the opposite lateral edge is bifacially flaked and the end adjacent to the graver tips exhibits a ragged sinuous edge chipped and crushed from use. The graver point is chipped and dulled from use. The bifacially flaked edge is evenly sinuous and very slightly dulled. The implement is triangular in cross section. Length 39.0 mm, width 29.0 mm, thickness 13.0 mm; chert.

**Modified Flakes** (23 specimens, Plate 19p–r, Plate 201, Plate 21m, p, q). Flakes of various sizes and shapes with minute intentional chipping on at least one edge. Some are thick and the chipping on these usually is larger and of greater extent. All appear to be tools utilized once and then discarded. Possibly some of the larger specimens were retained for later use. Length 84.0 to 30.0 mm, width 61.0 to 20.0 mm, thickness 14.0 to 2.0 mm; chalcedony (nine), chert (seven), pitch stone (three), fossil wood (two), obsidian (one), quartzite (one).

**Utilized Flakes** (four specimens, Plate 19o). These are small thin flakes with tiny use flake scars on one or more edges. Naturally sharp edges were used without modification. Length 29.0 to 20.0 mm, width 21.0 to 18.0 mm, thickness 5.0 to 3.0 mm; chert (four).

**Miscellaneous** (eight specimens). Small fragments from the edges of unifacially and bifacially flaked implements of undetermined shape and size. Scrapers and knives appear to be represented; chalcedony (four), chert (four).

### **Rough Stone**

**Edge-Ground Cobble** (one specimen). An elliptical cobble with a small flattened facet on one lateral edge. The flattened area measures approximately 45.0 mm in length and 10.0 mm in width. The cobble shows no other evidence of use. Length 127.0 mm, width 80.0 mm, thickness 40.0 mm; igneous rock.

**Pigment** (one specimen). A small rounded piece of hematite. Length 7.0 mm.

### **Bone**

#### **Awls**

**Scapula Awl** (one specimen, Plate 22b). Made from part of the *pre-spinous fossa* of a scapula, probably of deer or mountain sheep. One end is tapered to a sharp point. To form the point part of one surface was removed along with the exposed cancellous bone. The remaining dense bone was tapered to a point. The proximal end is ragged and the awl may not be complete. Length 73.0 mm, width 13.0 mm, thickness 8.0 mm.

**Splinter Awls** (two specimens, Plate 22a, c). Made of splinters of mammal long bone. One is long and narrow with a long tapering tip. The distal half exhibits overall diagonal striations made during shaping. It is not polished. The second is a small splinter with a short narrow tip. The distal portion is highly polished. Length 92.0 and 38.0 mm, width 7.0 and 9.0 mm, respectively.

**Awl Tips** (seven specimens). The distal portions of broken awls. All are made of split mammal long bone. Five are long and narrow and two have edges that form an angle of about 25 degrees from the tip. All are well polished. Length 63.0 to 18.0 mm.

**Ulna Flakers** (11 specimens, Plate 22d). One is complete and is made from the proximal end of a mountain sheep ulna. The end of the olecranon was broken off and the rough edge slightly smoothed. The remaining shaft portion or body was slightly tapered and the end rounded. This end is chipped and pitted from use. Length 117.0 mm.

There are ten distal portions of various lengths. All apparently were treated in the same fashion as the above specimen. All have chipped and pitted tips. Length 94.0 to 19.0 mm.

**Splinter Flakers** (two specimens). Splinters of mammal long bone with tapered tips. The tips were formed by rubbing the bone on an abrasive surface, probably stone, transversely to the longitudinal axis. They were not polished. These could be awls but the tips are flaked and pitted. They may have been flakers. Only one is complete. Length 96.0 mm.

**Bone Tubes** (three specimens, Plate 22h, n). Sections of mammal long bone, two humeri, and one femur, with smoothed ends. One is raggedly broken at both ends with only a very slight amount of smoothing. Another is darkened at one end by burning. The interior surface is somewhat darker and the tube may have been a pipe. The others are not burned. Length 78.0 to 56.0 mm.

**Grooved Bone** (three specimens, Plate 22f, g). Fragments of mammal long bone with encircling V-shaped grooves or beveling at one end. In the latter instance the bone was grooved part way through and then snapped off. They may represent fragments of tubes broken during manufacture. One is broken beyond the groove and beveled at a low angle removing most of the groove. The bevel is highly polished. Two are charred and whitened by burning. Length 43.0 to 36.0 mm.

**Beads** (six specimens, Plate 22e, i–m). Sections of small mammal long bone rounded and polished at both ends. One is broken at both ends and may not be a bead. Length 34.0 to 12.0 mm, Diameter 6.5 to 3.0 mm.

**Miscellaneous** (one specimen). A fragment of a smoothed and polished bone tool. It is split and shattered but one side is rounded. It may be a portion of an awl.

**Smoothed Bone** (one specimen). A fragment of bone with all edges smoothed probably during passage through an animal or human alimentary tract. Length 24.0 mm, width 13.0 mm.

**Beaver Tooth** (one specimen). A part of a split beaver tooth broken at both ends. The exterior surface at one end bears many parallel transverse striations. There is a small area of parallel striae near the other end. Length 34.0 mm.

## CULTURE LAYER 30

### *Description*

Culture Layer 30 consisted of a thick, extensive accumulation of charcoal-stained earth, ash, and rubble containing numerous fire pits. The profiles as shown in Figures 2 and 3 suggest two merged occupational levels. Edgar stated that during excavation, the level was considered to represent two cultural strata and artifacts were segregated correspondingly. Charcoal samples for radiocarbon dating were selected in order to determine temporal differences. However, no artifactual differences were observed and charcoal from the lower part of the stratum assayed younger than samples from the upper portions. Subsequently, the thick level was considered to be one occupation layer deposited over a lengthy period. If artifactual differences did exist in two individual strata they were obscured, probably by activities of the prehistoric inhabitants of the period. The digging of fire pits and shifting of the deposits probably account for the homogeneity of the artifacts from top to bottom and the failure of the radiocarbon dates to indicate any temporal differences within the level.

The aforementioned mixture between this level and Culture Layer 28 appears to have been largely downward. I suspect that in most instances, portions of the lower part of Culture Layer 30 were excavated as Culture Layer 28 with the resultant inclusion of Culture Layer 30 artifacts in the lower stratum.

## **Features**

**Fire Pits 66–70.** Circular, bowl-shaped pits filled with burned rock, ash, and charcoal. They probably functioned as roasting pits. Fire Pit 69 was located against the shelter wall. It had a maximum diameter of 120.0 cm and was 90.0 cm deep. The other four were somewhat smaller.

**Fire Pits 71–89.** Circular to oval, basin-shaped fire pits containing ash, charcoal-stained earth, and scattered charcoal. Actual dimensions are unknown, but one was at least 82.0 cm in diameter.

## **Artifacts**

### **Chipped Stone**

#### **Projectile Points**

**McKean Lanceolate** (26 specimens, Plate 23a–n). This group of projectile points varies greatly in size. The basic form is lanceolate. Lateral edges range from smoothly convex to nearly parallel with the widest point generally near midpoint. A few, especially the smaller specimens, are widest at the base. Basal edges vary from smoothly concave to deeply notched. Cross sections are lenticular, but thickness is variable. One specimen, possibly a knife, is alternately beveled on the left. Flaking ranges from excellent to mediocre with a majority exhibiting fair flaking quality. One specimen exhibits obvious grinding of the edges near the base. Four have serrated edges. Length 96.0 to 17.5 mm, width 34.0 to 12.5 mm, thickness 11.0 to 2.0 mm; chalcedony (15), chert (two), fossil wood (eight), silt stone (one).

**Straight Stem, Indented Base** (six specimens, Plate 24, 1–o). This group of projectile points varies in size. Lateral edges range from straight and parallel to weakly convex. Shoulders are wide and vary from straight to sloping. The stem edges are parallel or nearly so. Bases are notched and the resulting projections are rounded. Flaking is generally fair in quality. Lateral edges are retouched. All cross sections are biconvex. The stem and basal edges are lightly ground. Length not determined, width 27.0 to 19.0 mm, thickness 6.0 to 5.0 mm; quartzite (four), chert (one), fossil wood (one). Two measurable specimens are 58.0 mm and 48.0 mm long. Another is much larger than the rest.

**Expanding Stem, Notched Base** (five specimens, Plate 24g–k). These projectile points have slightly convex lateral edges and prominent straight to sloping shoulders. The stems expand moderately. The bases exhibit a deep, wide, V-shaped notch at least half as deep as the length of the stem. The resulting ears are rounded. Chipping is fair and cross sections are biconvex. The stem edges and basal notches are smoothed. Length 50.0 to 32.0 mm, width 25.0 to 15.0 mm, thickness 7.0 to 4.0 mm; chert (two), chalcedony (one), fossil wood (one), quartzite (one).

**Short Stem, Indented Base** (seven specimens, Plate 24p–r). This group has parallel to slightly convex lateral edges. Short stems, which make up one-fifth to one-fourth the total length, join the body of the point at weak straight to sloping shoulders. One specimen has short blunt barbs. Stems are parallel-edged or slightly expanding and have notched bases. The basal notches are of moderate depth and range from narrow to wide. Flaking is generally mediocre but the edges are retouched. Two are serrated. All cross sections are biconvex. Length 45.0 to 40.0 mm (estimated), width 22.0 mm to 16.0 mm, thickness 6.0 mm to 4.0 mm; chalcedony (four), chert (two), quartzite (one). These may be merely variants of the eared, indented base category, although stemming does appear to be deliberate.

**Eared, Indented Base** (41 specimens, Plate 24a–f). Lateral edges range from nearly straight to moderately convex. Wide, shallow side notches combined with indenting of the base form markedly expanding stems or ears. Basal indenting ranges from shallow and concave, to nearly straight, to deeply notched. Chipping varies from good to poor with a majority exhibiting fair workmanship. Lateral edges are retouched and seven specimens are serrated. With one exception cross sections are biconvex. One is made

on tabular chert and only the periphery is worked. Grinding is not apparent. Length 40.0 to 20.0 mm, width 30.0 to 13.0 mm, thickness 9.0 to 4.0 mm; chalcedony (27), chert (10), fossil wood (three), quartzite (one).

**Crude, Eared, Indented Base** (two specimens, Plate 24t, u). Small and very crude replicas of the eared, indented base category that possibly represent toy points. One has convex edges. The edges of the other are straight. Both are side-notched points and have weakly concave bases. Chipping is limited to the edges and is poorly executed. Cross sections are uneven. Length 22.0 and 19.0 mm, width 15.0 and 13.0 mm, thickness 3.0 and 2.5 mm, respectively; chert (one), fossil wood (one).

**Large Side-Notched, Concave Base** (one specimen, Plate 24w). Similar to the Pahaska Side-Notched type but is thicker and less well made. The lateral edges are weakly convex and the base is moderately concave. Shallow, wide side notches are placed transversely. Chipping is poorly controlled. The cross section is thick and biconvex. The basal edge and lateral edges below the notches are smoothed. Length 33.0 mm, width 22.5 mm, thickness 7.0 mm; pitch stone.

**Crude Trianguloid** (one specimen, Plate 24v). An extremely crude point made on a plano-convex flake. One lateral edge is nearly straight, but the other is convex causing asymmetry. The base is straight. Flaking is limited to the periphery of both faces. The cross section is plano-convex. Length 26.0 mm, width 15.0 mm, thickness 3.0 mm; chalcedony.

**Miscellaneous** (70 specimens). One is the basal portion of a chalcedony point or possibly a drill with convex lateral edges and a straight base (Plate 24s). The edges taper slightly to the base from a point about one-fourth the length from the base. The specimen is thick with a rounded median ridge on one face. The lateral edges and base are finely retouched. When complete it was approximately 40.0 to 45.0 mm long. The fragment is 16.0 mm wide and 7.0 mm thick. Eleven basal fragments are too incomplete to classify. Of these, eight are of chalcedony and three are of chert. Unidentifiable medial fragments total 14 specimens. Materials represented are chalcedony (seven), petrified wood (five), and chert (two). There are 44 apical fragments. Two fit basal fragments recorded as having been recovered from Culture Layer 28. Three are serrated, and one is from a crude flake point. Thirty are of chalcedony, seven of chert, six of petrified wood, and one of obsidian.

### **Knives**

**Lanceolate** (three specimens, Plate 25a). Bifacially chipped and retouched knives with weakly convex lateral edges and convex bases. Chipping varies from good to poor and the bases are thinned. Cross sections are biconvex. Two are broken. Length of complete knife 78.0 mm, width 35.0 mm, thickness 10.0 mm; chalcedony (one), chert (one), quartzite (one).

**Small Lanceolate** (one specimen). This specimen could be a projectile point. It is crudely chipped and has straight lateral edges and a straight base. The cross section is thick and biconvex. The edges are haphazardly retouched. Length 48.0 mm, width 20.0 mm, thickness 8.0 mm; chalcedony.

**Small Ovate** (one specimen, Plate 25n). A small, well-made specimen with convex lateral edges and convex base. The tip is missing. Both faces are flaked overall, the base is bifacially thinned, and all edges are retouched. The cross section is lenticular. Length 35.0 mm (estimated), width 20.0 mm, thickness 5.0 mm; chalcedony.

**Crude Ovate** (two specimens, Plate 25b). These have the appearance of blanks but seem to be finished implements. They exhibit convex lateral edges and weakly convex bases. Both faces exhibit a minimum of flaking but edges are bifacially retouched. Both are plano-convex in cross section. Length 50.0 and 49.0 mm, width 33.0 and 28.0 mm, thickness 10.0 and 7.0 mm, respectively; chert (two).

**Large Ovate?** (one specimen, Plate 25e). The base is missing, but the specimen appears to have been ovate in outline. The lateral edges are smoothly convex. Both faces are percussion flaked and the edges are bifacially retouched. The cross section is biconvex. Both lateral edges are lightly smoothed from use. Length ca. 95.0 mm, width 49.0 mm, thickness 11.0 mm; quartzite.

**Triangular** (three specimens, Plate 25c). These exhibit weakly convex lateral edges and straight to weakly concave bases. With one exception, both faces are flaked overall. One is chipped only along the edges. Lateral edges are bifacially retouched and bases are thinned. Cross sections are biconvex. Two are broken. Length of complete specimen 42.0 mm, width 27.0 mm, thickness 9.0 mm; chert (two), chalcedony (one).

**Crude Trianguloid** (three specimens, Plate 25f). Crudely formed knives, generally trianguloid in form. Lateral edges are convex and bases are straight. Crude percussion flaking covers both faces. Two specimens have one bifacially retouched edge. The third is retouched on both lateral edges. Cross sections are unevenly biconvex. Length 39.0 to 36.0 mm, width 30.0 to 24.0 mm, thickness 9.0 to 8.0 mm; chert (two), fossil wood (one).

**Stemmed** (one specimen, Plate 25i). A small ovate knife with a small, parallel-edged stem projecting obliquely from one side of the base. The implement is made on a flake and only the edges are chipped. Length 35.0 mm, width 25.0 mm, thickness 5.0 mm; chalcedony.

**Concave Edged** (one specimen, Plate 25h). A flake or blade with one convex and one concave lateral edge. The wide end is straight, the other is convex. The concave edge is bifacially chipped. The other edge is roughly flaked unifacially. The cross section is trianguloid. Length 42.0 mm, width 28.0 mm, thickness 7.0 mm; fossil wood.

**Beveled** (one specimen, Plate 25j). One end of an alternately beveled knife with gradually converging, straight edges. The base and extreme tip are missing. Both faces are flaked overall. The edges are bifacially retouched in addition to the beveling. The cross section is trapezoidal. Length 61.0 mm, width 33.0 mm, thickness 9.0 mm; chert.

**Plate Chalcedony Knives** (two specimens, Plate 25d). These are trianguloid knives made of thin plates of chalcedony. Both faces retain areas of light brown cortex. Lateral edges and bases are bifacially flaked. Chipping is generally of poor quality. Both specimens are broken, and one is considerably larger. Length of smaller specimen 48.0 mm (estimated), width 25.0 mm, thickness 6.0 mm.

**Flake Knives** (three specimens, Plate 25g). Two are rectangular flakes, one is trianguloid. All have one bifacially flaked lateral edge. One of the rectangular specimens has unifacial chipping on the other lateral edge. They are otherwise unmodified. Length 43.0 to 34.0 mm, width 34.0 to 20.0 mm, thickness 10.0 to 4.0 mm; chert (two), quartzite (one).

**Miscellaneous** (47 specimens). Seven apical fragments, five basal sections, five medial fragments, and seven lateral portions of bifacially flaked knives of undetermined form. In addition there are 13 fragments of plate chalcedony knives and 10 small knife fragments. One of the medial fragments is covered with a hematite stain; chalcedony (14), chert (14), plate chalcedony (13), fossil wood (six).

## Scrapers

**Crude End Scrapers** (three specimens, Plate 25q–s). One is ovate with weakly convex lateral edges, a convex base, and a convex bit (Plate 25r). It is made on a flake triangular in cross section. The bit and one lateral edge are unifacially chipped. Length 55.0 mm, width 34.0 mm, thickness 12.0 mm; chert.

Another is roughly circular in outline and has a high-angle scraping edge on one side (Plate 25q). It is made on an irregular flake otherwise unmodified. Length 51.0 mm, width 48.0 mm, thickness 18.0 mm; chert.

The third is a small ovate flake with a high-angle bit at one end and unifacially chipped lateral edges (Plate 25s). It is plano-convex in cross section. Length 41.0 mm, width 25.0 mm, thickness 5.0 mm; chalcedony.

**Large Ovate Scraper** (one specimen, Plate 25k). A large, flat, ovate flake with high-angle, unifacial chipping along all but a small portion of the periphery. The dorsal surface bears two large percussion flake

scars and an area of cortex. The ventral surface is unaltered and bears a low bulb of percussion. Length 92.0 mm, width 71.0 mm, thickness 16.0 mm; chert.

**Small Ovate Scraper** (one specimen, Plate 25t). A small ovate bifacially percussion flaked scraper with a high-angle unifacially chipped bit on one lateral edge. A large section of the bit is missing. There is some sporadic retouching of the remainder of the periphery. The cross section is irregular. Length 44.0 mm, width 30.0 mm, thickness 11.0 mm; fossil wood.

**Semicircular Scraper** (one specimen). Fashioned from a thick semicircular flake with a flat triangular facet forming one side. There is a roughly flaked high-angle bit opposite the flat side. The remaining edges are unifacially retouched. The cross section is plano-convex. Length 53.0 mm, width 45.0 mm, thickness 21.0 mm; fossil wood.

**Serrate Scraper** (one specimen). A crudely chipped rectanguloid scraper with a rough serrated bit at one end. The bit consists of three adjacent concave, high-angle, unifacially chipped areas forming two triangular projections. This edge is dulled from use. Length 35.0 mm, width 28.0 mm, thickness 12.0 mm; chalcedony.

**Flake Scraper** (one specimen). A thin irregularly shaped flake with a high-angle scraping edge on one concave side. The remainder of the periphery is unifacially retouched. Length 35.0 mm, width 31.0 mm, thickness 5.0 mm; chalcedony.

**Crude Side Scraper** (one specimen, Plate 25u). An ovate flake with a unifacially chipped scraping edge along most of one side. The dorsal surface exhibits cortex. The cross section is trianguloid. Length 50.0 mm, width 37.0 mm, thickness 12.0 mm; fossil wood.

#### **Drills**

**Expanded Base** (one specimen, Plate 25, 1). A crudely formed drill with a narrow shaft projecting from a large ovate stem or butt. The shaft is bifacially chipped. The stem is only cursorily worked. The shaft tip is missing. Length 45.0 mm, width 42.0 mm, thickness 10.0 mm; fossil wood.

**Stemmed, Concave Base** (one specimen, Plate 25o). Apparently a stemmed, indented base projectile point was modified to make this specimen. At the shoulder point, the edges contract sharply to form the broken shaft. The entire implement is bifacially chipped and retouched. Length 23.0 mm, width 15.0 mm, thickness 4.0 mm; chert.

**Flake Drill** (one specimen, Plate 25p). A small triangular flake with a tiny bifacially chipped drill at the apex. The shaft is alternately beveled and worn from use. Both lateral edges of the flake are unifacially retouched. Length 25.0 mm, width 18.0 mm, thickness 4.0 mm; fossil wood.

**Miscellaneous** (two specimens). Two drill shafts lacking bases. One is large with a gradually expanding shaft. The other is an extreme tip portion; chalcedony (one), chert (one).

**Gravers** (16 specimens, Plate 26a, b). These form a heterogeneous group consisting of variously shaped flakes and core-like pieces of stone with fortuitously formed points that were subsequently used as gravers with little or no modification. A few have worked edges and were used for other purposes as well as functioning as gravers. Length 63.0 to 26.0 mm, width 36.0 to 16.0 mm, thickness 15.0 to 6.0 mm; chalcedony (seven), chert (seven), fossil wood (two).

**Denticulate Flake** (one specimen, Plate 25m). A small, thin flake with one irregular and one convex edge. The convex edge is roughly serrated to form a saw-like edge. Length 34.0 mm, width 16.0 mm, thickness 4.0 mm; chalcedony.

**Knife Chopper** (one specimen, Plate 26f). A thick, roughly chipped lanceolate implement with a sinuous cutting or chopping edge slightly battered from use. The other edge is also sinuous, and a segment near one end might have served as a scraper. The cross section is unevenly biconvex. Length 81.0 mm, width 35.0 mm, thickness 18.0 mm; fossil wood.

**Modified Flakes** (54 specimens, Plate 26c-e). Stone flakes of various shapes and sizes with one or more edges exhibiting intentional unifacial retouching. They form a heterogeneous group and no special tool type appears to be represented. Length 57.0 to 16.0 mm, width 42.0 to 15.0 mm, thickness 16 to 2.5 mm; chert (26), chalcedony (14), fossil wood (13), obsidian (one).

**Utilized Flakes** (19 specimens). Various shaped stone flakes showing evidence of use without intentional modification. One or more edges bear tiny use flake scars. Length 95.0 to 24.0 mm, width 82.0 to 12.0 mm, thickness 24.0 to 2.0 mm; fossil wood (seven), chalcedony (six), chert (six).

**Choppers** (four specimens, Plate 26h, i). Ovate to trianguloid unifacially chipped implements with one battered sinuous edge. All are made on stream cobbles and retain cortex on one face. The other face is roughly percussion flaked. The utilized edge was prepared by the removal of large percussion flakes to thin the edges. Cross sections range from roughly biconvex to unevenly plano-convex. Length 85.0 to 58.0 mm, width 77.0 to 52.0 mm, thickness 45.0 to 25.0 mm; fossil wood (three), chert (one).

**Miscellaneous** (17 specimens). Pieces of broken unifacially and bifacially flaked implements too fragmentary to identify. A majority probably were knives or scrapers; chalcedony (seven), chert (six), fossil wood (four).

### **Rough Stone**

**Grinding Slab** (one specimen, Plate 27). A split waterworn boulder or cobble with a smooth and striated area on the waterworn face. The slab is pentagonal in outline and has rough edges. The grinding surface is darkly stained with hematite. Length 35.8 cm, width 23.4 cm, thickness 4.5 cm; volcanic rock.

**Fragment of Grinding Slab?** (one specimen). A small trapezoidal piece of tabular stone with one smooth but uneven face. It may be a grinding slab fragment. Length 67.0 mm, width 45.0 mm, thickness 19.0 mm; sandstone.

**Hand Stone?** (one specimen). A flat ovate cobble that could have served as a hand stone or muller. One face is smooth but there is no apparent evidence of use such as striated areas. One edge is battered. Length 129.0 mm, width 80.0, thickness 43.0 mm; volcanic rock.

**Cobble Chopper** (one specimen). An ovate piece of rock either split or naturally broken from a river cobble. The narrower end and one lateral edge are dulled and battered from use in cutting or crushing some substance. Length 138.0 mm, width 114.0 mm, thickness 50.0 mm; volcanic rock.

**Pigment** (one specimen). A small, thin, irregularly shaped piece of hematite-bearing stone probably used as a source of pigment. Length 24.0 mm, width 17.0 mm, thickness 7.0 mm.

### **Bone and Antler**

#### **Awls**

**L-Shaped Scapula Awl** (one specimen, Plate 28e). A part of the caudal border of a mountain sheep scapula with a portion of the *infraspinous fossa* forming the horizontal leg of the L. The dorsal surface was removed from the distal half. The remainder was rounded and tapered to a sharp point. The proximal end is rough and unmodified. Length 121.0 mm, width 20.0 mm, thickness 9.0 mm.

**Small Ulna Awl** (one specimen, Plate 29d). A small delicate awl made from a split ulna of a small unidentified mammal. The proximal end is rounded and smoothed. The shaft tapers to a thin sharp point. All edges are smoothed. Length 47.0 mm.

**Rabbit Incisor Awl or Punch** (one specimen, Plate 29c). A rabbit incisor with the distal end beveled laterally at a low angle. The proximal end is rounded and smoothed. Transverse abrading marks are visible at both ends. Length 32.0 mm, width 2.5 mm, thickness 2.0 mm.

**Splinter Awls** (two specimens, Plate 28d, f). Splinters of unidentified mammal long bone with long, round, tapered, well-polished points. The exterior of one is pitted and scarred at the proximal end. One

edge is transversely scarred and subsequently smoothed. The proximal ends are rough and unaltered. Length 95.0 and 93.0 mm, width 8.0 and 7.0 mm, respectively.

**Awl Fragments** (three specimens, Plate 28b). These consist of the tapered cylindrical distal portion of an awl with missing tip, a flat splinter of bone with a short polished tip, and a broken splinter awl with a cylindrical shaft. Length 50.0 to 30.0 mm.

**Splinter Punches** (three specimens, Plate 28c). Splinters of bone with somewhat blunted and polished points. Edges of the distal ends are rounded and polished. Proximal ends are unmodified. The tips are blunter than those of the awls suggesting a function requiring a stronger tool. Length 124.0 to 68.0 mm, width 14.0 to 12.5 mm.

### **Flakers**

**Ulna Flakers** (six specimens, Plate 29a, f). The distal ends of broken knapping tools made from the proximal halves of mammal ulnae, probably of mountain sheep and deer. All are broken beyond the olecranon process. Distal ends are rounded and smoothed. Ends are lightly pitted and scarred from use. Length 106.0 to 44.0 mm, width 14.0 to 8.0 mm. Form suggests that they are like the complete specimen from Culture Layer 28.

**Splinter Flaker** (one specimen). A splinter of mammal long bone tapers to a point at one end. The rough edges adjacent to the point are smoothed. The point is slightly pitted and scarred. The rough edges of the proximal end are partially rounded and smoothed. Length 86.0 mm, width 14.0 mm.

**Tip of Antler Flaker** (one specimen). The beveled tip of an antler tine chipped and scarred from use. The bevel was formed by the removal of a large flake or piece of antler. The resulting sharp edges are smoothed. Length 32.0 mm, width 11.0 mm, thickness 9.5 mm.

**Bone Edge Flakers** (two specimens). Half round lengths of mammal long bone with deep, rough, parallel-oblique cuts along the edges. One is smoothed at one end. The other is flattened and smoothed. Length 107.0 and 88.0 mm, width 12.0 and 9.0 mm, respectively.

**Fine Flakers** (two specimens, Plate 29b, e). Both are broken and probably originated as awls. One is long and needle-like with a blunt scarred tip. It is round in cross section. The other is wide and triangular with a beveled tip that is crushed and scarred. Both are highly polished and generally well made. Length 63.0 and 53.0 mm, width 15.0 and 5.5 mm, respectively.

**Split Antler Flaker?** (one specimen, Plate 28a). A section of split elk antler beam tapering to a long narrow point beyond the beam-branch juncture. The branch was removed. Both edges and the proximal end are rounded and smoothed. The distal end is missing. Length 30.4 cm, width 4.3 cm, thickness 19.0 mm.

### **Worked Scapula**

**Scapula Knives?** (four specimens, Plate 28k, m). Ovate pieces of scapula consisting of *pre-* and *post-spinous fossae* and the scapular spine. The edges of the spine and pre-scapular *fossa* are thick, rounded, and smoothed. The edge of the *postspinous fossa* is much thinner but rounded and smoothed. Spines are either convex or triangular in outline. One specimen is badly shattered. A cutting function is suggested but the evidence is not conclusive. Length 98.0 to 83.0 mm, width 42.0 to 32.0 mm, height 32.0 to 28.0 mm. The scapulae are from mountain sheep. The edges show no evidence of use but all are highly polished, possibly from use. They must have been used on some soft, nonabrasive material.

**Smoothed Scapula** (one specimen, Plate 28l). A rectanguloid fragment of *postspinous fossa* with smoothed lateral edges. One edge is very thin and polished. One end is smoothed but the opposite end is broken. No function is suggested. Length 57.0 mm, width 43.0 mm, thickness 1.5 mm.

**Worked Scapula** (one specimen). An irregularly shaped piece of *postspinous fossa* with a few long striations on one face. All edges are broken. Length 54.0 mm, width 31.0 mm, thickness 1.0 mm.



## Pipes

**Tubular Pipes** (four specimens, Plate 28h, i). Sections of mammal long bone rounded and smoothed at both ends. One contains a thick carbon cake. The others have charred interiors and slight caking. A fragment may be part of one larger specimen. All are broken. Length of the most complete specimen is 58.0 mm, diameter 18.0 mm; length of the large broken specimen is 64.0 mm, diameter 23.0 mm.

## Tubes

**Plugged Tube** (one specimen, Plate 28g). A section of femur shaft, possibly canid, rounded and smoothed at both ends. One end is plugged with wood. Length 66.0 mm.

**Tube Fragments** (two specimens, Plate 29s). Fragments of small long bone rounded and smoothed at one end. Surfaces were striated during manufacture. One has an oblique end. Lengths undetermined, diameter of one specimen 9.0 mm.

**Phalanx Tube** (one specimen, Plate 29r). The shaft of a first phalanx of mountain sheep with both ends roughly cut. The ends are partially rounded and smoothed. The exterior is scratched and cut and has a light red stain on one side. Length 34.0 mm.

**Discard** (one specimen). A piece of cut long bone apparently discarded after making a tube. One end is slightly smoothed. Length 44.0 mm, diameter 20.0 mm.

## Beads

**Rabbit Phalange Beads** (15 specimens, Plate 29i–m). Rabbit phalanges with both ends removed. Some ends are broken and uneven. Others are cut or ground evenly. All ends are rounded and polished. Length 39.0 to 14.0 mm.

**Bird Bone Bead** (one specimen). A section of unidentified bird bone smoothed at both ends. It is identical in form to the rabbit bone beads described above. Length 25.0 mm, diameter 4.0 mm.

**Bone Beads** (six specimens, Plate 29g, h, n). Identical in form to the rabbit bone beads but of larger unidentified mammal bone. Two bear short, parallel, transverse cut marks or striations, two on one, three on the other. One is discolored by fire. Two are split. Length 15.0 to 8.0 mm, diameter 6.0 to 5.0 mm.

## Miscellaneous

**Antler Bar** (one specimen, Plate 28j). A flat, tapered bar of antler with convex ends. The edges and ends are rounded. Its function is not determined. Length 67.0 mm, width 18.0 mm, thickness 7.5 mm.

**Small Spatula** (one specimen). A small, flattened piece of bone with a short wide shaft and rounded tip. Both faces are smoothed and one entire lateral edge is rounded and polished. The other edge is smoothed only at the distal end. The tip is polished from use. Length 42.0 mm, width 15.0 mm, thickness 3.0 mm.

**Grooved Bone** (three specimens, Plate 29t, u). Split sections of mammal long bone with V-shaped encircling grooves. The end of one is rounded. Possibly it may have been a decorated bone tube. One specimen definitely is a discarded section of cut bone. Length 62.0 to 42.0 mm, width 22.0 to 14.0 mm.

**Worked Antler** (one specimen). A small, trapezoidal fragment of antler smoothed at one end. It is transversely striated on the exterior surface and stained light red. Length 30.0 mm, width 13.0 mm, width 5.0 mm.

**Smooth Bone** (one specimen). A small, thin, hexagonal fragment of bone smoothed during passage through a human or animal alimentary tract. Length 20.0 mm, width 9.0 mm, thickness 2.0 mm.

**Cut Bone** (eight specimens). Pieces of cracked and split mammal long bone and one rib with multiple cutting marks probably made during butchering.

## Shell

**Beads** (two specimens, Plate 29p, q). One is a small shell (*Olivella* sp.) with both ends ground flat and smooth (Plate 29p). Length 6.5 mm, diameter 6.5 mm. The identifier stated that the shell may be from the Gulf Coast of the United States (Morrison 1968). The other is made of the freshwater snail *Leptoxis praerosa* from the Tennessee River region (Plate 29q). One side adjacent to the aperture was ground flat exposing the columella. A small rectanguloid hole was made in the whorl near the aperture, apparently for suspension. Length 10.0 mm, width 9.0 mm, thickness 5.0 mm.

**Fragments** (five specimens, Plate 29o). The illustrated specimen is a fragment of *Margaritifera margaritifera falcata*. The other four are unidentified. All have broken edges but exhibit no obvious evidence of purposeful alteration. The dimensions of the illustrated specimen are: length 24.0 mm, width 14.0 mm. The identifier stated that the species "... lives in the rivers of the Pacific slope and the upper Missouri tributaries only above Great Falls, Montana. This mussel is recorded as having been eaten by the Indians 'East of the Cascades.' Whether this particular shell came from the Madison River, Montana, or the Snake River tributaries in Teton Co., Wyoming, would be impossible to prove. It was brought in either as food or ornament" (Morrison 1968).

**Snail** (one specimen). The shell of the land snail *Oreohelix subrudis* (Reeve). They are native to the region and apparently not eaten or otherwise used by the Indians (Morrison 1968).

## Wood

**Foreshaft** (one specimen). The tapered proximal end of a broken foreshaft. Tapering is uneven and roughly done. The surface bears spiral rasp-like cuts. A small area of bark remains near the tapered portion. The shaft bears evidence of having been smoothed. 117.0 mm long, 7.0 mm in diameter. In all probability the dart and throwing stick were in use during the time of deposition of Culture Layer 30, but this foreshaft would appear to be exceedingly light and fragile for use as a dart. However, many of the projectile points from the layer are small, and the shaft would easily accommodate them. Apparently darts of wide size range were used. It has been suggested that spiral rasping of shaft plugs may have been applied to provide a firm grip in the socket (Jennings 1957:182).

**Digging Sticks** (two specimens, Plate 30a, d). Smooth, bluntly pointed ends characterize these implements. One (Plate 30d) consists of a thick wide piece of wood split from a limb. The lateral edges curve smoothly to the tip. There is a slight tapering of both faces beginning about 120.0 mm from the end. The point and edges of the tapered portion are rounded and smoothed. The other end is roughly broken and split. 39.3 cm long, 45.0 mm wide, 27.0 mm thick. The second specimen (Plate 30a) is a long, cylindrical stick with one end beveled at a low angle to form a point. The tip edges are smoothly rounded. Charring suggests the tip was fire hardened. The proximal end is charred and rounded; 44.2 cm long, 29.0 mm in diameter.

**Pointed Sticks** (two specimens). One is more carefully finished and may have had a specific use. It is a stick with an angular bend near the middle. The concave or ventral side is flattened throughout the entire length. The edges taper to a blunt point. The point is smooth and rounded, but any evidence of polishing or use marks has been obscured by a soft deteriorated condition of the wood. The proximal end is broken; 155.0 mm long, 14.0 mm wide, 12.0 mm thick.

The other is a broken stick unevenly tapered to a blunt point. A 10.0 mm section of the tip is smooth, nearly circular in cross section, and forms a snout-like projection. This portion appears to have resulted from a particular use, possibly in making basketry. The tapered area proximal to the snout bears some spiral striae. The remainder is unaltered. 103.0 mm long, 13.0 mm wide, 10.0 mm thick.

**Split and Cut Stick** (one specimen). A short section of split stick roughly cut at both ends. One end was sawed nearly through and snapped off. Near this end are two parallel transverse cuts on the split face. A small section of wood was split away from the end to the farthest cut. The other end was similarly cut off and then roughly whittled to form a crude tenon-like projection. Bark remains on much of the outer surface. 60.0 mm long, 13.0 mm wide, 9.0 mm thick; *Prunus melanocarpa* (chokecherry).

**Split Stick** (one specimen). A short piece, broken at one end and severely frayed at the other. It shows no apparent evidence of use. 94.0 mm long, 10.0 mm wide, 6.0 mm thick.

**Smoothed Wood** (two specimens). One is a small triangular fragment from an implement with smooth rounded edges. The fragment is longitudinally tapered; it is 33.0 mm long, 15.0 mm wide, 9.0 mm thick. Another is a long, narrow piece split from an object with rounded edges. This and the above fragment may be parts of the same implement; 93.0 mm long, 9.0 mm wide, 8.0 mm thick.

**Notched Wood** (one specimen). A badly deteriorated curved piece of wood with a semicircular notch in one edge 25.0 mm from one end. The notch is about 10.0 mm in diameter. It is poorly preserved and all evidence of workmanship or use has been obliterated; 107.0 mm long, 17.0 mm wide, 13.0 mm thick.

**Cut Wood** (nine specimens, Plate 30b, c). Two methods of cutting wood are represented. Six were cut by sawing a deep encircling groove, and then breaking off an end (Plate 30b). One is cut at both ends, one was simply twisted and broken off at one end, and four are incomplete specimens.

Three other examples were cut by sawing two opposing deep grooves and then breaking off an end. (Plate 30c). One is beveled by sawing at the other end. Another is charred and somewhat smoothed. The third is cut at both ends by grooving. They range from 255.0 mm to 30.0 mm long, 23.0 to 11.0 mm diameter; *Prunus melanocarpa* (chokecherry).

**Miscellaneous** (two specimens). A fragment of firewood burned at one end and gnawed by a beaver at the other. It is slightly rounded and probably is a piece of driftwood from the nearby river. The other specimen is a section of twig twisted and broken from a larger piece. The broken end is badly frayed from twisting. The other end is burned; *Salix* sp.

## **Plant Fiber**

**Cordage** (52 specimens, Plate 31a–g). Culture Layer 30 yielded 52 pieces of cordage including three fragments of netting. All are worn and apparently represent discarded scraps of no further use. The longest piece measures 17.0 cm. Locally available materials were used to manufacture the cords. Grass leaves and yucca are most numerous with lesser amounts of juniper and sagebrush bark.

Technically, the cordage is very uniform. S-twists and Z-twists are nearly equally represented. Of 43 twisted examples, 23 are S-twist and 25 are Z-twist. Three specimens consist of pieces of untwisted bark tied together or knotted. A majority, or 37 examples, have diameters of 3.0 to 4.0 mm. Of 42 measurable specimens, 41 are of medium to hard twist as determined by measuring the helix angle (Osborne and Osborne 1954:1099). Technical data are provided in Tables 5 and 6.

Five knots are represented. Except for 13 examples of netting-knots in net fragments, the overhand knot and clove hitch are most common, four and three examples, respectively. There is one example each of the granny knot and half hitch. One knot is unidentified.

**Coiled Basketry** (one specimen, Plate 31k). The single small fragment of basketry from Culture Layer 30 is deteriorated and unfortunately was coated with a preservative before being properly cleaned. It apparently has a two split rod stacked foundation with interlocking stitch. The stitching passes through one of the split rods. There are roughly three stitches per centimeter measured along one coil and two coils per centimeter. Both the rods and the stitching are *Salix* sp. (willow).

**Coils of Basketry Stitching** (two specimens, Plate 31h, j). Small oval rolls of *Salix* sp. (willow) strips probably used to stitch coiled basketry. To secure the bundle, the running end was looped around the roll, passed around the strip, and then doubled back under the strip forming a loose knot. Both ends of one specimen are broken. The strips range from 2.0 to 3.0 mm in width. 49.0 and 42.0 mm long, 29.0 and 28.0 mm wide, respectively.

**Miscellaneous** (two specimens). One long strip of bark of *Prunus melanocarpa*. It is irregularly folded and encrusted with soil. No use is suggested. Another specimen is a small wad of shredded sagebrush bark.

Table 5. Metric data and materials of cordage from Culture Layer 30.

Diameter (mm)	2-Ply S-Twist	2-Ply Z-Twist	1-Ply S-Twist	1-Ply Z-Twist	No Twist	Total
1.5	1	—	—	—	—	1
2.0	—	2	1	—	—	3
2.5	2	1	—	1	—	4
3.0	9	13	1	—	3	26
4.0	6	8	—	—	—	14
5.0	2	1	—	—	—	3
8.0	1	—	—	—	—	1
Total	21	25	2	1	3	52

Material	2-Ply S-Twist	2-Ply Z-Twist	1-Ply S-Twist	1-Ply Z-Twist	No Twist	Total
Grass Leaves	5	13	1	—	—	19
<i>Yucca</i> sp.	8	2	—	1	—	11
<i>Artemisia</i> sp.	1	2	—	—	3	7
<i>Juniperus</i> sp.	2	—	—	—	—	2
Unidentified	5	8	—	—	—	13
Total	21	25	2	1	3	52

Table 6. Degree of twist in cordage from Culture Layer 30.

Twist	Soft 10°–20°	Medium 21°–30°	Hard 31°–50°
2-Ply, S-Twist	—	6	15
2-Ply, Z-Twist	1	14	6
Total	1	20	21

## Hide and Hair

**Tanned Hide** (one specimen, Plate 26j). A small piece of tanned mountain sheep hide. Small patches of the hair remain at one end; length 49.0 mm.

**Hair** (one specimen). A fist-sized ball of mountain sheep hair intermixed with grass and sagebrush bark. It may have served as padding for footwear.

## Earth

**Fired Silt** (one specimen, Plate 26g). A small ball of fired silt ovate in outline and cross section. It was purposely molded in the hand and fired. Its use is undetermined. Length 52.0 mm, width 40.0 mm, thickness 25.0 mm. Similar balls of fired silt and sand were recovered from Occupation III of Bottleneck Cave (48BH206) in Bighorn Canyon (Husted 1969:54–55, Plate 29q, r). This occupation has radiocarbon dates of  $8160 \pm 180$  BP and  $8040 \pm 220$  BP. A large ball from this stratum was cut in half to determine its content. It consisted of a central core of silt with an outer layer of sand. Smaller balls consisted of sand. No use for these could be determined.

## CULTURE LAYER 32

### *Features*

The layer contained two fire pits. Fire Pit 90 was a bowl-shaped, rock-filled fire pit identical to those in Layer 30. It was about 107.0 cm in diameter, 41.0 cm deep and contained many rocks. Fire Pit 91 was a shallow, basin-shaped, ash-filled pit 61.0 cm in diameter and 7.6 cm in maximum depth.

### *Artifacts*

#### Chipped Stone

##### Projectile Points

**Corner-Notched, Straight Base, Wide Stem** (nine specimens, Plate 32b–d, f–j). These projectile points vary considerably in size. The lateral and basal edges are straight. The corner notches form sharply expanding stems slightly narrower than the lateral barbs. Flaking is generally mediocre, but the lateral edges are retouched. Cross sections are biconvex. All but one have ground bases. Six are broken. Length 40.0 to 19.5 mm, width 24.0 to 19.0 mm, thickness 6.0 to 4.0 mm; chert (seven), obsidian (one), quartzite (one).

**Corner-Notched, Convex Base, Narrow Stem** (two specimens, Plate 32a, e). Long projectile points with slightly convex lateral edges and bases. The notching removed part of the basal edge and is oriented so as to form moderately expanding stems. One is well flaked while the other is crudely fashioned. Both are laterally retouched. Cross sections are biconvex. Length 46.0 and 44.0 mm, width 21.0 and 20.0 mm, thickness 5.0 and 6.5 mm, respectively; chert (one), obsidian (one).

**Miscellaneous** (six specimens). Three midsections, probably of the corner-notched, straight base, wide stem projectile point category. The stems are missing or broken. Two are of chert and one is of chalcedony. There are three apical fragments, two of obsidian and one of chalcedony.

##### Knives

**Lozenge-Shaped** (one specimen, Plate 33a). Made on a large flake shaped roughly like a parallelogram. Chipping is limited mainly to the periphery. One entire lateral edge is roughly bifacially flaked forming a sinuous edge. One-half of the opposite edge is similarly treated. The remainder is naturally sharp and has minute, even, fine unifacial retouching. The cross section is biconvex. Length 72.0 mm, width 42.0 mm, thickness 9.0 mm; fossil wood.

**Miscellaneous** (two specimens, Plate 321, Plate 33g). One is the apical portion of a knife with one weakly convex edge. It is made on a large flake, triangular in cross section. Chipping is limited to the periphery. Before the flaking was applied, or at least prior to resharpening, the tip was used to cut or groove

an abrasive substance, probably rock. The tip is beveled in two directions. Parallel striae are oriented parallel to each beveled area. The flake was probably held with the edges vertical and point downward to cut or groove rock. Both sides of the tip may have been used in this manner. Subsequently, one edge was bifacially chipped and the other edge was unifacially and more steeply flaked. The cross section is plano-convex. Length 32.0 mm, width 32.0 mm, thickness 8.5 mm; obsidian.

The second is a triangular fragment from the edge of a bifacially flaked implement, probably a knife; chalcedony.

### Scrapers

**End Scraper** (one specimen, Plate 33b). Made on a hemispherical flake struck from the end of a river cobble. Several large percussion flakes were removed from one side forming a rough edge with five triangular projections. The other side bears a high-angle roughly chipped scraping edge. This edge is chipped and crushed from use. Length 54.0 mm, width 52.0 mm, thickness 22.0 mm; quartzite.

**Side Scrapers** (two specimens, Plate 32p, Plate 33f). One is a roughly pentagonal flake with a triangular projection on one lateral edge and another at one corner on the same edge. The other lateral edge has unifacial high-angle flaking the entire length. The two projections served as graters and are rounded and smoothed from use. The flake is triangular in cross section. Length 53.0 mm, width 32.0 mm, thickness 10.0 mm; chert.

The second is half of a small ovate side scraper with steep unifacial chipping on the edges. Both surfaces are flat and parallel. Length 25.0 mm, width 11.0 mm, thickness 4.0 mm; chert.

**Graver** (one specimen, Plate 32m). This is a trianguloid flake triangular in cross section. The pointed end exhibits minute unifacial flaking and is lightly dulled. Several flakes were removed from the dorsal surface of the opposite end forming a sharp rounded edge. It is chipped and scarred. Both lateral edges bear tiny use flake scars. Length 45.0 mm, width 19.0 mm, thickness 6.0 mm; chert.

**Gouge** (one specimen, Plate 32n). A flake or blade with straight convergent edges and convex ends. It is triangular in cross section. Longitudinal flakes were removed from both ends on the dorsal surface and from the ventral face of the wider end forming sharp edges. Both ends were retouched. These edges are chipped and dulled. One lateral edge bears discontinuous unifacial retouching. Both lateral edges are lightly scarred and dulled. Length 55.0 mm, width 27.0 mm, thickness 8.0 mm; chert.

**Chopper** (one specimen, Plate 33c). This appears to be half of a small bifacially flaked chopper with rough sinuous edges. The ventral surface appears to have been nearly flat and the dorsal surface appears to have been keeled or turtle-backed. The remaining edge is scarred and battered. Length 48.0 mm, width 34.0 mm, thickness 22.0 mm; chert.

**Modified Flakes** (four specimens, Plate 32k, o, Plate 33d). One is a large, thin, roughly oval flake with unifacial flaking along the entire periphery. Another is a long triangular flake similarly treated. The third is a small, thick, rectanguloid flake with a short area of unifacial flaking on one lateral edge. The fourth is a rectangular flake with unifacial retouching along the two longer edges. Length 62.0 to 27.0 mm, width 40.0 to 20.0 mm, thickness 9.0 to 5.0 mm; chert (three), obsidian (one).

**Utilized Flake** (one specimen). An irregularly shaped flake with one thin edge. This edge is minutely chipped and scarred from use. Length 57.0 mm, width 31.0 mm, thickness 8.0 mm; quartzite.

**Miscellaneous** (two specimens). Fragments of small bifacially flaked implements. Possibly they are broken projectile points; chert (two).

### Bone

**Flakers** (two specimens, Plate 35a, b). These appear to be broken flakers made of mammal bone, possibly ulnae. Rough edges are chipped and scarred. Length 122.0 and 117.0 mm, width 10.0 and 13.0 mm, respectively.

**Smoothed Bone** (one specimen). A small chip of bone with rounded, smoothed edges. It was probably smoothed during passage through an animal or human alimentary tract. Length 21.0 mm, width 10.0 mm.

### **Plant Fiber**

**Cordage** (two specimens, Plate 31i). Both are two-ply Z-twist cords, one of soft twist and one of medium twist. Length 78.0 and 33.0 mm; diameter 3.5 and 3.5 mm. The helix angles are 20° and 25°. The soft, twisted specimen consists of grass leaves. The other specimen is too badly deteriorated to identify.

## **CULTURE LAYER 34**

### **Features**

At least three rock-filled roasting pits, Nos. 92–94, occurred in this stratum. Two were about two feet six inches (76 cm) in diameter and the third measured about two feet (61 cm) in diameter. Depths were not recorded.

### **Artifacts**

#### **Chipped Stone**

##### **Projectile Points**

**Corner-Notched, Convex Base, Wide Stem** (16 specimens, Plate 34a–i). Generally large projectile points with straight to convex lateral edges and wide expanding stems with convex bases. The corner notches are very deep and wide. The stems vary from slightly to sharply expanding. Chipping is poor to fair and the lateral edges are retouched. Cross sections are biconvex. The basal edges are ground smooth. Length 50.0 to 29.0 mm, width 30.0 to 20.0 mm, thickness 8.0 to 4.0 mm; chert (nine), fossil wood (three), pitch stone (two), chalcedony (one), obsidian (one).

**Corner-Notched, Straight Base, Wide Stem** (one specimen, Plate 34j). Identical in form to the major projectile point type in Culture Layer 32. The distal half is missing. Length 45.0 mm (estimated), width 22.0 mm, thickness 5.0 mm; chert.

**Miscellaneous** (three specimens). Two distal fragments of chalcedony and one medial fragment of chert.

##### **Knives**

**Basal Fragment** (one specimen). The convex basal portion of a small knife, probably triangular when whole. It is thin and has fine bifacial chipping along the edges. The central portions of both faces are not chipped. Length 24.0 mm, width 11.0 mm, thickness 3.0 mm; chert.

**Distal Fragments** (three specimens, Plate 34m). One is large and has slightly convex lateral edges. It is flaked overall and the edges are evenly retouched. The flaking is very good. The cross section is biconvex. Two are smaller, thicker, and crudely made. They are roughly flaked overall and retouching is haphazard. Both are plano-convex in cross section. Length 41.0 to 27.0 mm, width 37.0 to 25.0 mm, thickness 8.0 to 6.0 mm; obsidian (two), fossil wood (one).

**Miscellaneous** (four specimens). Small fragments of bifacially retouched implements, probably knives. Their former shape and size is undetermined; chert (three), chalcedony (one).

**Ovate End Scraper** (one specimen, Plate 33e). A large plano-convex end scraper with a semicircular high-angle scraping edge. The proximal end is thin and the edge is ragged. It is roughly chipped from the ventral surface. The bit is well flaked. Retouching extends along both lateral edges nearly to the base. The dorsal surface is weathered cortex. Length 59.0 mm, width 47.0 mm, thickness 11.0 mm; chert.

**Drill** (one specimen, Plate 34l). Made on a projectile point of the major type found in this Culture Layer. The lateral edges near the tip have been retouched to form a short, slightly tapering drill shaft. The extreme tip is dulled and the edges are chipped and crushed from use. Length 35.0 mm, width 22.0 mm, thickness 7.0 mm.

**Triangular Graver** (one specimen, Plate 34k). A triangular implement with two concave edges and graver tips on two apices. The two concave edges are steeply flaked but the other (basal) edge is essentially unaltered. One tip is broken but the other is chipped and scarred from use. Both faces are unmodified. Length 20.0 mm, width 20.0 mm, thickness 4.0 mm; chert.

**Blank** (one specimen, Plate 34n). A broken, thick, percussion-flaked blank probably ovate in form when whole. The dorsal surface is rough and keeled while the ventral surface is nearly flat resulting in a trianguloid cross section. There is no retouching on the edges. The apical portion is missing. Length 46.0 mm, width 32.0 mm, thickness 16.5 mm; chert.

**Modified Flakes** (nine specimens, Plate 34o). Thin flakes of various shapes and sizes with intentional, fine, unifacial flaking along one or two edges. They appear to be tools used once or twice and then discarded. Length 46.0 to 23.0 mm, width 27.0 to 15.0 mm, thickness 6.0 to 3.0 mm; obsidian (three), chert (three), chalcedony (two), fossil wood (one).

**Miscellaneous** (four specimens). Bifacially and unifacially flaked fragments of implements too fragmentary to identify. One may have been a scraper but it is badly spalled from intense heating. One edge is chipped and crushed from use. The remainder are small fragments of tools; chalcedony (two), chert (one), fossil wood (one).

### **Rough Stone**

**Cobble Hammer** (one specimen). A large rectanguloid cobble oval in cross section. Both ends are pitted. The specimen was used to crush bones or a vegetable food. There is a large, deep, oval pit on one face measuring 80.0 mm long, 55.0 mm wide, and 14.0 mm deep. Length 185.0 mm, width 95.0 mm, thickness 50.0 mm; volcanic rock.

### **Bone**

**Awl Tips** (two specimens, Plate 35c, i). Both are made from pieces of split mammal long bone. One side shows cancellous bone. The other side and both edges are smoothed and polished. One (Plate 35c) has a long tapering tip. The other (Plate 35i) has a sharp tip, but the edges diverge at a greater angle. The proximal ends are missing. Length 73.0 and 31.0 mm.

**Flaker Tip** (one specimen, Plate 35d). A smoothed bone implement with a blunt rounded tip. The tip is pitted and chipped and both lateral edges are scarred from use. Length 36.0 mm.

### **Shell**

**Bead** (one specimen, Plate 35j). A thick nearly circular bead with a large hole through the center. The edges are smoothed and slightly rounded. Length 12.5 mm, width 11.5 mm, thickness 6.0 mm. The central hole is 3.75 mm in diameter.

### **Wood**

**Shaft Discards** (two specimens, Plate 35g, h). One (Plate 35h) is the discarded section of a shaft slotted for insertion of a stone implement. One end bears the thin projection removed to form the slot. The other end is tapered to a blunt point. The taper exhibits many diagonal cut marks made during the tapering process. The extreme tip is split, probably naturally; however, it is also somewhat frayed suggesting some use. Possibly it represents a bunt point subsequently removed in favor of a stone point. The slot on the reworked shaft would have been too narrow to accommodate the points recovered from this level and would have had to be widened. Length 60.0 mm, diameter 12.0 mm. The discard represents a standardized method of slotting shafts. A full description of the process is provided below in the section describing similar specimens from Culture Layer 36.

The second (Plate 35g) is the discarded section from a socketed shaft. The section was removed by making three deep cuts leaving uncut the central portion of the diameter desired for the hole in the shaft. The end was then bent, twisted, and pulled from the shaft. The other end is treated in a fashion similar to



that of the above specimen except that the tip is diagonally beveled in addition to tapering. Length 65.0 mm, diameter 15.0 mm, plug diameter 8.0 mm.

**End of Foreshaft** (one specimen, Plate 35k). The pointed proximal end of a foreshaft. It bears numerous oblique cut marks oriented downward to the left. The tip is bluntly pointed. Length 32.0 mm, diameter at break 10.0 mm.

**Cut Wood** (four specimens, Plate 35e, f). One is a section of branch cut at both ends (Plate 35f). One end was shallowly grooved around the circumference. Then it was sawn half way through and broken off. The other end was sawn approximately one-third the way through around approximately two-thirds of the circumference. Then the end was broken off. This end possibly represents an unsuccessful attempt to form a socketed shaft. If so, the plug broke off at the cut and was not removed. Length 140.0 mm, diameter 16.0 mm; chokecherry (*Prunus melanocarpa*).

Another branch was sawed half way through at one end and broken off (Plate 35e). The other end was simply twisted and broken off. Length 150.0 mm, diameter 11.0 mm; chokecherry (*Prunus melanocarpa*).

A third piece of wood was deeply grooved around its circumference and snapped off. Both ends evidence the same treatment. Length 50.0 mm, diameter 13.0 mm; chokecherry (*Prunus melanocarpa*).

A twig was deeply grooved around all but a small section of the circumference and then broken. The other end is deteriorated, but there is a suggestion that it was tapered and diagonally cut like the two shaft discards described above. Near the center of the twig are a series of encircling cuts of shallow depth. Length 61.0 mm, diameter 8.0 mm; chokecherry (*Prunus melanocarpa*).

#### **Plant Fiber**

**Cordage** (one specimen, Plate 31l). A section of two-ply Z-twist cordage of medium twist. Length 212.0 mm, diameter 3.5 mm, helix angle 25°; sagebrush (*Artemisia* sp.).

## **CULTURE LAYER 36**

### ***Description***

This stratum consisted of a substantial accumulation of charcoal-stained earth and rubble containing many fire pits. It was about 30 cm in maximum thickness and extended beyond the limits of excavation at the north and south ends of the shelter. The central portion was badly disturbed by uncontrolled digging (Figure 4). Fire pits occurred throughout the stratum many penetrating fire pits lower in the level indicating an extended period of occupation.

### ***Features***

The presence of 30 fire pits was noted in profiles and sketches of Culture Layer 36. Twenty-two (Fire Pits 95–116) were rock-filled roasting pits. These ranged from about two (61 cm) to six (183 cm) feet in diameter and from one (30 cm) to two (61 cm) feet in depth. All contained rock and/or river cobbles, ash, and charcoal.

There were at least eight basin-shaped fire pits containing ash and charcoal (Fire Pits 117–124). These generally were shallower than the roasting pits, and ranged from two (61 cm) to six (183 cm) feet in diameter. Depths ranged from a few inches to about one foot (30 cm).

### ***Radiocarbon Date***

A portion of a mountain sheep skin robe covering a burial found in the occupation zone was submitted for radiocarbon dating. The date is 1230 ± 110 BP (I-1009).

## ***Burial***

A human burial was unearthed in the process of cleaning up the vandals' excavations. The burial was put on display in the Whitney Gallery of Western Art, Cody, Wyoming, soon after its removal. The director asked that the body not be disturbed thus preventing its study. I was not present during excavation of the burial but Edgar provided the following descriptive information. Plate 5 illustrates the burial *in situ* and after cleaning. The head is depicted in Plate 6

The initial discovery was the rock cairn covering the burial. These rocks appeared initially to be from the wall or ceiling, but after removal of some of them, part of a tanned mountain sheep skin robe was exposed. Further excavation revealed a human foot.

The cairn was located adjacent to the shelter wall. The body lay near the base of Cultural Level 36, and the top of the cairn was several cm below the top of the layer. The interment appears to have occurred early in the occupation period. Occupational debris had accumulated against and over the cairn. No indication of a pit was observed.

The body lay on its right side in a flexed position facing the shelter wall and with the head to the west. One of the wrist joints was broken. The hair at the front of the head was cropped to about three inches (8 cm) long. That on the back of the head was considerably longer. The feet and hands were bare.

A mountain sheep robe or blanket was wrapped around the body and was sewn together with sinew. A piece of cord in the hair is thought to have been used to tie the long hair at the back of the head. Near the left ear was an ornament made of feathers and fur strips twisted together. The ends of the strip were then joined to form a coil. These artifacts were on display with the body and unavailable for study.

## **Chipped Stone**

### **Projectile Points**

**Rose Spring Corner-Notched**<sup>2</sup> (107 specimens, Plate 36a–x). Considerable variation in size, form, and workmanship is exhibited by this type. They are small and triangular with straight to weakly convex lateral edges. A small number have slightly concave edges, a few edges are recurved. The latter trait is manifest on the shorter specimens. Deep, moderately wide to wide notches are placed in the base-corner region to form narrow stems with parallel to moderately expanding edges. The stem usually extends beyond the barbs. The barbs are characteristically long and sharp, but in a minority of specimens they are short or practically nonexistent forming more of a shoulder. Many specimens are asymmetric, i.e., one barb is longer than the other.

Variation in workmanship produces specimens ranging from jewel-like points to crude poorly formed projectiles. Chipping ranges from excellent to mediocre. A few specimens are made on curved flakes with only partial chipping of one or both faces. The concave face usually exhibits less chipping. A majority, or about 67 percent, are serrated. Length 49.0 to 17.0 mm (average 30.0 mm), width 19.0 to 10.5 mm (average 14.0 mm), thickness 6.0 to 2.0 mm (average 3.0 mm); chert (54), chalcedony (29), petrified (19), obsidian (two), basalt (one), pitch stone (one), quartzite (one).

**Miniature Points** (five specimens, Plate 36y–a', d'). Miniature examples of the Rose Spring Corner-Notched type made on curved flakes. Three mirror the outline of the larger type specimens. Two are stemmed, but barbs are not formed by the slight corner-notching. Flaking is limited to the peripheries of both faces, but the convex face exhibits large overall flake scars. Cross sections are plano-convex.

One specimen (Plate 36y) retains a short section of arrowshaft and sinew wrapping. The shaft was probably not more than 3.0 mm in diameter. The point stem was slipped into the shaft and bound with sinew.

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<sup>2</sup> *Senior Author's Note:* In the original manuscript, the Rose Spring Corner-Notched projectile point type was prematurely and without sufficient justification given the name Wapiti Corner-Notched. Readers are urged to avoid use of this label and to use Rose Spring Corner-Notched as the proper designation for the type. Rose Spring Corner-Notched will be used in discussion of this point type in the remainder of the report.

These tiny points probably represent toys. A small bow described below came from Culture Layer 36 and surely is a toy. Length 16.0 to 11.5 mm, width 10.0 to 7.5 mm, thickness 2.5 to 2.0 mm; chalcedony (four), fossil wood (one).

**Crude Flake Points** (four specimens, Plate 36b', c'). These probably are children's products and an attempt to make points of the Rose Spring Corner-Notched type. All are asymmetric with one straight and one convex edge. Crude corner-notching forms wide stems with parallel edges. Bases are straight. The points are made on rough flakes triangular in cross section. Chipping is limited to the peripheries of both faces. One has no visible chipping. Only one is complete. Length 24.0 to 18.0 mm (estimated), width 13.0 to 9.0 mm, thickness 4.0 to 2.5 mm; fossil wood.

**Thick, Side-Notched, Convex Base** (two specimens, Plate 36e'). Both are broken and the form cannot be determined. Deep, wide side notches form expanding fan-like stems with convex bases. The bases and edges of the notches are thinned. Both are very thick suggesting that these may have been hafted drills. Cross sections are biconvex. The fragments are 6.0 and 5.0 mm thick. Length ? and 30.0 mm (estimated), width 15.0 and 12.0 mm, thickness 6.0 and 5.0 mm, respectively; chert.

**Side-Notched, Straight or Concave Base** (one specimen, Plate 36f). A triangular point with weakly convex lateral edges. It exhibits a concave base and side notches near the base. One corner of the base is missing. Chipping is fair and there is some uneven retouching. The cross section is biconvex. Length 30.0 mm (estimated), width 13.0 mm, thickness 3.0 mm; fossil wood. This specimen is identical to the major type found in Culture Layer 37 and may have originated in that level.

**Miscellaneous** (48 specimens). There are 37 distal sections, 10 medial portions and one basal fragment. The indicated size range is compatible with the Rose Spring Corner-Notched<sup>3</sup> point and these probably represent this type; chalcedony (six), chert (24), fossil wood (13), obsidian (five).

## Knives

**Corner-Notched Knives** (two specimens, Plate 37a). Large, bifacially flaked, triangular knives with deep corner notches and expanding stems with convex or irregular bases. The lateral edges are irregular. Chipping is poorly executed but edges are retouched. Cross sections are biconvex. One specimen is broken. Length 90.0 and 80.0 mm (estimated), width 35.0 and 35.0 mm, thickness 9.0 and 7.0 mm, respectively; fossil wood and chert.

**Lanceolate Knife** (one specimen, Plate 37b). A bifacially flaked knife with weakly convex edges and a convex base. Both faces are flaked overall but edge retouch is discontinuous. The cross section is lenticular. Length 57.0 mm, width 25.0 mm, thickness 9.0 mm; chalcedony.

**Ovate Knives** (eight specimens, Plate 37c, d). Ovate knives made on plano-convex flakes. These are formed mainly by percussion with a minimum of edge retouching. Both lateral edges are lightly dulled from use. Two are broken. Length 51.0 to 37.0 mm, width 33.0 to 25.0 mm, thickness 9.5 to 8.0 mm; fossil wood (six) and chert (two).

**Triangular, Straight Base Knife** (one specimen, Plate 37i). The basal portion of a small bifacially flaked knife with straight edges and rounded basal corners. All edges are bifacially retouched. The cross section is biconvex. Length 45.0 mm (estimated), width 26.0 mm, thickness 8.5 mm; chert.

**Triangular, Convex Base Knife** (one specimen, Plate 37h). A thin, well-flaked knife with straight lateral edges and a convex base. All edges are retouched and the cross section is lenticular. The tip is missing. Length 45.0 mm (estimated), width 25.0 mm, thickness 4.5 mm; fossil wood.

**Asymmetric Knives** (three specimens, Plate 37f, g). These specimens exhibit convex bases one convex edge and one straight or weakly concave edge. All are roughly percussion flaked and retouched prin-

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<sup>3</sup> *Senior Author's Note:* One fragmentary Rose Spring Corner-Notched point was found with nine Avonlea-like points in Occupation III of the Mangus site (24CB221) in Bighorn Canyon. The stratum has radiocarbon dates of 1070 ± 70 BP and 1050 ± 70 BP (Husted 1969). It is thus possible that this side-notched point did originate in Culture Layer 36.

cipally along the convex edge. Cross sections range from biconvex to plano-convex. Length 66.0 to 41.0 mm, width 34.0 to 24.0 mm, thickness 9.5 to 4.5 mm; fossil wood (two), chert (one).

**Long, Narrow Knives** (three specimens, Plate 37e). The distal portions of knives or possibly lance heads. From the tip the straight edges diverge at a low angle forming a long narrow blade. The basal form is undetermined. Flaking is fair to good and cross sections are biconvex. The edges are secondarily chipped. The largest fragment is 63.0 mm long; chert, fossil wood, and quartzite.

**Miscellaneous Knives** (20 specimens). Fragments of broken, bifacially flaked knives. One appears to be part of a knife with convex edges and a flat base. It is made of fossil wood. There are nine medial sections. One is chalcedony, four are chert, and four are fossil wood. Ten are apical fragments. Four of these are chalcedony, two are chert, and four are fossil wood.

### Scrapers

**Oval End Scrapers** (six specimens, Plate 38a–d). These are made on plano-convex flakes and subsequently chipped to an oval outline. At one or both ends is a high-angle unifacially chipped scraping edge. All or most of the remainder of the periphery is unifacially chipped. The dorsal surfaces bear several percussion flaking facets. The ventral surfaces are essentially flat. Three specimens are broken. Length 47.0 to 39.0 mm width 70.0 to 34.0 mm, thickness 18.0 to 9.0 mm; chert (five), fossil wood (one).

**Flake End Scrapers** (six specimens, Plate 38e–i). Ovate to irregular in outline and made on thin flakes. The scraping edge is semicircular and placed at the thin edge of the flake. Chipping may or may not extend to one or both lateral edges. The implements are otherwise unaltered. Length 64.0 to 37.0 mm, width 47.0 to 30.0 mm, thickness 12.0 to 7.0 mm; chert (two), fossil wood (four).

**Tanged End Scrapers** (three specimens, Plate 38l, n, o). Made on plano-convex flakes, the specimens exhibit straight to convex scraping edges. The opposite end has a bluntly pointed projection showing evidence of use as a graver or gouge. The scraping edges are high-angle and finely flaked. There is some uneven retouching of the lateral edges. The dorsal surfaces are percussion flaked, but the ventral surfaces are unaltered. Length 43.0 to 30.0 mm, width 26.0 to 20.0 mm, thickness 8.0 to 6.0 mm; chalcedony (one), chert (two).

**End Scraper-Graver** (one specimen, Plate 38k). A thin, ovate, high-angle end scraper with a small graver tip projecting obliquely at one end of the scraping edge. The lateral edges are unifacially retouched but the base is unaltered. The dorsal surface bears three longitudinal flake scars. The ventral surface is not worked except for a few small flakes removed from the bulb of percussion. Length 38.0 mm, width 25.0 mm, thickness 7.0 mm; pitch stone.

**Triangular End Scraper** (one specimen, Plate 38m). A small, thin, triangular end scraper with a crudely formed high-angle bit. The lateral edges are irregularly retouched. It is otherwise unaltered. Length 25.0 mm, width 20.0 mm, thickness 4.0 mm; fossil wood.

**Crude End Scraper-Graver** (two specimens, Plate 38j). One is a thick trianguloid flake with a convex high-angle scraping edge at one end and graver tips at the other two apices. These tips are on fortuitously formed points and bear only tiny use flake scars. One surface is essentially flat. The other bears large percussion flaking scars. Length 60.0 mm, width 34.0 mm, thickness 11.0 mm; chert.

The second is a trianguloid flake struck from a pebble with a high central peak. One end bears a convex high-angle scraping edge. The other end has a graver tip at each corner. In addition there is a graver tip on each lateral edge. All of these small points are unifacially chipped. The entire periphery of the tool is also retouched. Length 43.0 mm, width 42.0 mm, thickness 24.0 mm; chert.

**Crude Ovate Scrapers** (four specimens, Plate 39a). Roughly ovate bifacially percussion-flaked scrapers with rough unifacial retouching. One face is weakly convex the other is strongly convex. Length 69.0 to 42.0 mm, width 54.0 to 35.0 mm, thickness 22.0 mm to 15.0 mm; fossil wood (three), quartzite (one).

**Side Scrapers** (five specimens, Plate 39b, c). Trianguloid to ovate pieces of stone with a unifacially chipped scraping edge along one side. One specimen has a roughly bifacially chipped edge opposite the scraping edge. Length 83.0 to 46.0 mm, width 46.0 to 35.0 mm, thickness 28.0 to 9.0 mm; fossil wood (three), quartzite (two).

**Scraper Planes** (three specimens, Plate 39d, e). Thick, ovate, “turtleback” scrapers with flat ventral surfaces. There is some discontinuous edge retouching. Two specimens have small triangular projections used as gravers. Length 51.0 to 42.0 mm width 40.0 to 35.0 mm, thickness 22.0 to 19.0 mm; fossil wood.

#### **Drills**

**Corner-Notched Drill** (one specimen, Plate 40a). Made on one of the corner-notched knives described above. The shaft’s tip is missing. Length ?, width 45.0 mm (estimated), thickness 7.0 mm; fossil wood.

**Expanded Base Drills** (three specimens, Plate 40b–d). Two exhibit ovate bases and long, narrow shafts. They are bifacially chipped and well formed. The other has a narrow shaft but the rectangular base is unretouched. Length 47.0 (estimated) to 35.0 mm, width 23.0 to 18.0 mm thickness 7.0 to 3.0 mm; chalcedony, chert, fossil wood.

**Miscellaneous Drills** (four specimens). Three are bifacially chipped drill shafts with lozenge-shaped cross sections; chalcedony (one), chert (two). The fourth is part of the shaft and base of what appears to have been an expanded base drill; chert.

#### **Gravers**

**Trianguloid Gravers** (two specimens, Plate 40e, f). These resemble short-shafted drills but lack the alternate crushing of the edges present on drills. Both are made on flakes and have a triangular projection formed by steep flaking on one face and low angle chipping on the other. The tips are blunt and have minute use flake scars. There is some sporadic retouching of the remaining edges. Length 23.0 and 13.0 mm, width 18.0 and 13.0 mm, thickness 5.0 and 3.0 mm; chalcedony and chert.

**Blade Gravers** (eight specimens, Plate 40h, i, 41a). Prismatic blades of various sizes with graver tips at the pointed end. All exhibit use flake scars on one or both lateral edges. One is intentionally retouched along one edge. Length 76.0 to 32.0 mm, width 35.0 to 14.0 mm, thickness 18.0 to 2.5 mm; chalcedony (two), chert (four), fossil wood (two).

**Rectangular Graver** (one specimen, Plate 41i). A rectangular piece of tabular stone with a graver point at one end formed by the chipping of two concavities in the edge. The chipping is unifacial and high-angle. Also there is a small semicircular scraping edge on one side and another at the end opposite the graver tip. This scraping edge is perpendicular to the dorsal surface. Length 49.0 mm, width 40.0 mm, thickness 15.0 mm; chert.

**Trapezoidal Gravers** (three specimens, Plate 40g). Made on trapezoidal flakes with triangular or trapezoidal cross sections. Both ends are pointed and bear evidence of use as gravers. One bears unifacial retouching along two converging edges. Length 52.0 to 44.0 mm, width 25.0 to 17.0 mm, thickness 16.0 to 8.0 mm; chalcedony (two), chert (one).

**Flake Gravers** (nine specimens, Plate 41b, d, e). Flakes of various shapes and thicknesses with fortuitous triangular projections used as gravers. Five are unifacially retouched on the points. Four were used without modification. Length 51.0 to 25.0 mm, width 36.0 to 17.0 mm, thickness 6.5 to 3.0 mm; chalcedony (one), chert (six), fossil wood (two).

#### **Blanks**

**Small Lanceolate Blank** (one specimen, Plate 41f). This specimen has nearly parallel edges that converge to a blunt tip and a weakly convex base. It is flaked overall but there is no edge retouch. It could be a knife, but the lack of any evidence of wear or retouching suggests that it is a blank, possibly for the long variety of Rose Spring Corner-Notched point. The specimen was broken into three sections. Length 48.0 mm, width 17.0 mm, thickness 5.0 mm; chert.

**Small Ovate Blanks** (four specimens, Plate 41g). Small ovate versions of the above specimen. They appear to be projectile point blanks. Length 33.0 to 24.0 mm, width 17.0 to 16.0 mm, thickness 4.0 to 3.0 mm; chert (three), fossil wood (one).

**Small Triangular Blanks** (two specimens, Plate 41h, j). These have straight lateral edges and weakly convex bases but are otherwise identical to the above four specimens. Length 33.0 mm, width 18.0 and 16.0 mm, thickness 4.0 and 3.0 mm, respectively; chert.

**Short Trianguloid Blanks** (two specimens, Plate 41k). Short wide versions of the above triangular specimens. Length 25.0 mm, width 20.0 and 18.0 mm, thickness 3.0 mm, respectively; chalcedony and fossil wood.

**Large Trianguloid Blanks** (three specimens, Plate 41c). Larger percussion-flaked blanks with straight to convex edges and straight or convex bases. There is no edge retouching. They appear to be knife blanks. Two are broken. Length 64.0 to 55.0 mm (estimated), width 38.0 to 30.0 mm, thickness 13.0 to 8.0 mm; chert (one), fossil wood (two).

### Flakes

**Modified Flakes** (135 specimens, Plate 39f–i). This group includes flakes of various shapes and thicknesses. One or more edges bear intentional unifacial retouching. They probably functioned as cutting and scraping tools. Retouched edges range from convex through straight to concave. Length 86.0 to 17.0 mm, width 61.0 to 13.0 mm, thickness 26.0 to 2.5 mm; chert (58), fossil wood (56), chalcedony (17), pitch stone (two), obsidian (one), quartzite (one).

**Utilized Flakes** (23 specimens). Various shaped flakes with one or more edges showing evidence of use without intentional modification. The altered edges bear tiny flake scars caused by use. Length 62.0 to 24.0 mm, width 40.0 to 19.0 mm, thickness 25.0 to 3.0 mm; fossil wood (13), chert (7), chalcedony (3).

### Choppers

**Oval** (one specimen, Plate 42b). A bifacially percussion-flaked implement with battered, sinuous edges. One face is more convex and better flaked than the other. The cross section is unevenly biconvex. Length 86.0 mm, width 74.0 mm, thickness 28.0 mm; chert.

**Semicircular** (one specimen, Plate 42a). A large, semicircular piece of stone with a plano-convex cross section. The dorsal surface is partially percussion-flaked with some cobble cortex remaining. The convex edge is battered from use. Length 122.0 mm, width 74.0 mm, thickness 36.0 mm; fossil wood.

**Crude Ovate** (six specimens, Plate 42c, d). Roughly ovate naturally thin or bifacially flaked implements with battered sinuous edges. All are made on river cobbles or large pebbles. Length 102 to 56.0 mm, width 80.0 to 45.0 mm, thickness 39.0 to 20.0 mm; fossil wood.

**Rough Chopper** (one specimen). A large river cobble from which several large percussion flakes were removed to form a jagged sinuous cutting edge. The bit is battered from use. Length 125.0 mm, width 110.0 mm, thickness 68.0 mm; igneous rock.

### Miscellaneous

**Drill Base?** (one specimen). A small, oval, bifacially flaked object with what appears to be a small portion of a drill shaft at one end; however, the shaft seems to have been extremely thin. It might also have been a reamer or graver. Length 27.0 mm, width 13.0 mm, thickness 5.0 mm; chert.

**Broken Stemmed Object** (one specimen). The medial portion of a bifacially flaked implement with broad deep side notches. It is broken across one side of the notches and just above or below the notches at the other end. Length 23.0 mm, width 21.0 mm, thickness 5.0 mm; chert.

**Broken Implements** (nine specimens). Fragments of unifacially and bifacially flaked objects too incomplete to identify.

## Rough Stone

### Axes

**Grooved Cobble Axe** (one specimen, Plate 43h). An oval river cobble with naturally flat ends. A pecked and incompletely smoothed semicircular groove completely encircles the cobble slightly to one side of center. A few large percussion flakes were removed from one face of the wider end to form a bit. The narrower end is bifacially percussion-flaked. Both ends are dulled from use, but the wider end appears to have had the most use. Length 163.0 mm, width 111.0 mm, thickness 47.0 mm; igneous rock.

**Notched Slab Axe** (one specimen, Plate 43a). A rectangular slab of stone with percussion-flaked side notches near the narrower end. One face is rounded. The other has several large flake scars that appear to have been naturally formed. The bit is unsharpened and battered. The poll is a flat facet. There is a sharp ridge between the notches on one face. This was lightly smoothed as were the notch edges to aid in hafting. Length 150.0 mm, width 121.0 mm, thickness 35.0 mm; volcanic rock. The specimen appears to have been used to break bones or some other food product. It was found lying beside the pitted cobble anvil described below.

**Cobble Anvil** (one specimen, Plate 43b). A flat ovate cobble with pitted areas in the center of each face. It appears to have functioned as a crushing platform in conjunction with the notched axe described above. Length 206.0 mm, width 158.0 mm, thickness 50.0 mm; igneous rock.

**Cobble Chopper** (one specimen, Plate 43f). A flat trianguloid cobble bifacially flaked along the convex narrower edge. This edge is battered and dulled. Length 192.0 mm, width 132.0 mm, thickness 45.0 mm; igneous rock.

**Hammerstones** (three specimens, Plate 43g). One (illustrated) is a narrow elliptical cobble pitted at both ends. Another is a nearly spherical cobble pitted at one end. The third is a flat trianguloid pebble pitted and battered at all three apices. The narrowest end received the most use. One face is slightly pitted, striated and stained with hematite. Apparently the pigment was ground on the pebble. Length 89.0 mm, width 62.0 mm, thickness 32.0 mm; igneous rock.

**Notched Pebbles** (three specimens, Plate 44b, d, e). Flat oval pebbles with semicircular notches near the center of both lateral edges. They are otherwise unaltered. These objects probably are net weights. Length 73.0 to 62.0 mm, width 53.0 to 45.0 mm, thickness 22.0 to 19.0 mm; volcanic rock.

**Painted Pebble** (one specimen, Plate 44c). A thin trianguloid pebble with a trianguloid area on one face painted with hematite. The painted area coincides roughly with the pebble periphery about 10.0 mm from the edges. Length 87.0 mm, width 85.0 mm, thickness 19.0 mm; volcanic rock.

**Wrapped and Tied Spall** (one specimen, Plate 44a). An oval rock spall wrapped and tied with a length of wolfberry stem (*Symphoricarpos occidentalis*). There is a broad shallow notch on one side and one end. These appear to be natural. The edges are smooth but there is no evidence that the smoothing is not natural. Length 90.0 mm, width 78.0 mm, thickness 18.0 mm; volcanic rock.

**Grinding Slabs** (three specimens, Plate 45a, b). Rectangular to ovate slabs of rock with very shallow, circular, smoothed depressions on one face. They do not appear to have been shaped. Length 39.0 to 34.0 cm, width 30.5 to 25.0 cm, thickness 10.2 to 6.0 cm; volcanic rock.

**Hand Stones** (two specimens, Plate 43c, e). One (Plate 43c) is a flat oval cobble with smoothed areas on each face. It was used in a back-and-forth motion. The other (Plate 43e) is a flat ovate cobble lightly smoothed on both faces. It lacks the definite flattening of the faces exhibited on the above specimen. Length 125.0 and 125.0 mm, width 103.0 and 87.0 mm, thickness 49.0 and 51.0 mm, respectively; volcanic rock.

**Edge-Ground Cobble** (one specimen, Plate 43d). A thin, oval cobble with a smoothed and flattened area along one lateral edge. The grinding surface is 70.0 mm long and 10.0 mm wide. Length 145.0 mm, width 98.0 mm, thickness 33.0 mm; igneous rock

**Miscellaneous** (three specimens). Three cobbles do not show obvious evidence of use. One is broken at one end but the break seems naturally caused. These may have come from roasting pits. Length 135.0 to 90.0 mm, width 100.0 to 69.0 mm, thickness 57.0 to 44.0 mm; volcanic rock.

**Pigment** (one specimen). An irregularly shaped piece of hematite-bearing stone apparently utilized as a source of red pigment. One side bears several worn and smoothed areas as if rubbed against a smooth surface. Length 113.0 mm, width 83.0 mm, thickness 42.0 mm.

### **Polished Stone**

**Pendants or Beads** (three specimens, Plate 40k–m). One specimen is a soapstone pendant elliptical but asymmetric in form. One lateral edge is nearly straight, the other convex. There is a hole near one end and the pendant is broken through the hole. There are seven transverse incisions on one face and six on the other. The edges are smoothed and rounded. Length 42.0 mm (estimated), width 14.0 mm, thickness 4.0 mm; soap stone.

Two others are oval beads or pendants. One has five transverse incisions on both faces. The other is plain. Both have small holes near the centers. All edges are smoothed and rounded. Length 21.0 and 18.0 mm, width 17.0 and 17.0 mm, thickness 4.0 and 4.0 mm, respectively; soapstone.

### **Bone**

**Tibia Awl** (one specimen, Plate 46a). A piece of bone split from the proximal end of a mountain sheep tibia. The tip is sharp and well polished, but the remaining edges are rough. The awl is decorated with two transverse incised lines near the base, two zigzag lines toward the tip and three incised circles between the two sets of lines. Length 124.0 mm, width 23.0 mm, thickness 8.0 mm.

**Perforated Awl** (one specimen, Plate 46c). A well-made awl constructed from the proximal end of an ulna from an animal the size of a deer or mountain sheep. It has a long, tapering, well-polished tip and an expanding base with a small hole 10.0 mm from the base. Length 91.0 mm, width 11.0 mm, thickness 3.0 mm.

**Decorated Awl** (one specimen, Plate 46b). A finely finished awl made from a piece of unidentified mammal bone. From a sharp tip the edges expand gradually to a slightly expanded base. The rough edge of the base is smoothed and the remainder of the awl is highly polished. There are two nonparallel incised lines across the awl near the base. Length 98.0 mm, width 17.0 mm.

**Rib Awl** (one specimen, Plate 46h). A curved awl made from the split rib of an unidentified mammal. The distal one-third is smoothed and polished. The remainder is rough. The broken proximal end is not smoothed. Length 88.0 mm, width 7.0 mm, thickness 3.0 mm.

**Splinter Awl** (one specimen, Plate 46g). A splinter of unidentified mammal bone with a tapering well-polished point. The proximal end is slightly smoothed but the split edges are unaltered. Length 97.0 mm, width 9.0 mm, thickness 6.0 mm.

**Scapula Awls** (four specimens, Plate 46d–f). Made from the proximal portions of unidentified mammal scapulae. The articular surfaces were removed and a piece of bone containing the scapular spine was cut from the anterior border. On some the spine was removed. One surface was cut or split away at the distal end and the remaining face was tapered, sharpened, and polished. Characteristic of this group is a rough serrated edge where the anterior border was cut from the scapula blade. Length 99.0 to 85.0 mm, width 21.0 to 15.0 mm, thickness 12.0 to 8.0 mm.

**Broken Awls** (11 specimens, Plate 46k). The illustrated specimen is the proximal end of a well-made awl or punch with nearly parallel edges. The specimen is oval in cross section and has a smoothed butt. It is smoothed and polished overall. Length 82.0 mm, width 8.0 mm, thickness 4.0 mm.

Three are the tips of narrow sharply pointed awls. Six represent the tips of wider awls with short sharp points. One appears to be the midsection of the latter type of awl.



**Splinter Flakers** (four specimens, Plate 46i, j, 1). Splinters of mammal long bone with blunt polished tips. The tips are finely pitted and scarred suggesting use as pressure flakers. Length 92.0 to 74.0 mm, width 14.0 to 7.5 mm, thickness 6.0 to 4.5 mm.

**Unilaterally Barbed Point** (one specimen, Plate 47b). A broken lance or harpoon point with three unilateral barbs. The tip is bluntly pointed as are the barbs. The entire surface is smoothed. Length 90.0 mm, width 13.0 mm, thickness 7.0 mm.

**Scapula Saw** (one specimen, Plate 47a). The anterior border of a scapula, possibly of *Ovis canadensis*, with the articular end removed. The jagged cut edge is shredded and frayed apparently from use in a back-and-forth direction. Length 190.0 mm, width 23.0 mm.

**Pendants** (two specimens, Plate 47j, k). One (Plate 47j) is a thin rectangular piece of smoothed and polished bone with an off-center projection at one end. It appears to have been broken and repaired. Possibly it was perforated at one time, broken, and the remaining part of the broken end reworked for suspension. Length 28.0 mm, width 12.5 mm, thickness 2.5 mm.

The other (Plate 47k) is part of a thin, perforated, rectangular or oval pendant broken through the hole. Length 20.0 mm, width 10.0 mm, thickness 1.0 mm.

**Bead** (one specimen, Plate 47l). A part of a cylindrical bead with a nearly encircling groove. One end is straight, the other oblique. Both ends are smoothed. Length 17.0 mm.

**Smoothed Bone** (one specimen). A small triangular piece of bone smoothed and polished during passage through a human or animal digestive tract. Length 22.0 mm, width 10.0 mm.

**Miscellaneous** (one specimen). A sliver of bone from a mammal ulna. It bears longitudinal striae, but its function cannot be determined.

**Bear Canine Tooth** (one specimen, Plate 47h). A canine tooth of *Ursus americanus*. It does not appear to be modified. Length 66.0 mm, width 18.0 mm, thickness 11.0 mm.

**Split Beaver Incisor** (one specimen, Plate 47i). An incisor tooth of *Castor canadensis* was split and the sharp ends smoothed. Its use is not determined. Length 65.0 mm, width 8.0 mm, thickness 5.0 mm.

## **Antler**

**Flakers** (three specimens, Plate 47c, e). Antler tines of *Odocoileus hemionus* with polished tips. The tips are scarred from use. The tip of the larger specimen is beveled. Length 150.0 and 101.0 mm.

**Wedge-Like Implement** (one specimen, Plate 47d). An antler tine of *Odocoileus hemionus* with the tip flattened from opposing faces to form a wedge with a convex edge. It is highly polished but shows no apparent evidence of a specific use. Length 88.0 mm.

**Hollowed Antler** (one specimen, Plate 47g). A section of antler tine with a hemispherical depression in the larger end. A raised lip encircles the depression. The smoothed lip extends beyond the outer edge of the tine that is also lightly smoothed. The other end is jaggedly broken. This object might have been used to support the butt of a drill or similar implement. Length 52.0 mm, diameter 15.0 mm.

**Broken Antler** (one specimen, Plate 47f). An antler beam, most likely of *Odocoileus*, broken off below the branch. It appears to be a discarded piece. Length 97.0 mm, diameter 33.0 mm.

## **Horn**

**Smoothed Horn** (one specimen, Plate 47m). A thin, narrow piece of horn of *Ovis canadensis* with a convex, rounded, and smoothed end. The exterior surface bears a number of random light cutting marks. Length 100.0 mm, width 28.0 mm, thickness 6.0 mm.

## Shell

**Bead or Pendant** (one specimen, Plate 40j). A thin, weakly curved, elliptical bead or pendant with a round hole at each end. One end is broken through the hole. Length 30.0 mm (estimated), width 12.0 mm, thickness 1.5 mm.

**Shell Fragment** (one specimen). A small piece of unidentified mussel shell. Length 18.0 mm, width 7.0 mm.

## Wood

**Arrowshafts** (10 specimens, Plate 48a–e, i–k). One entire but broken arrow. The specimen was not included in the artifact collection sent to the River Basin Surveys laboratory. The arrow is compound consisting of a *Salix* (willow) foreshaft and a main shaft of *Phragmites communis* (reed grass). The visible portion of the foreshaft is 14.1 cm long and 6.0 mm in diameter at the proximal end tapering to 4.5 mm diameter at the distal end. The proximal end is tapered to fit into the distal end of the cane rear shaft. The distal end is slotted and contains a Rose Spring Corner-Notched projectile point. The shaft is wrapped with sinew immediately below the projectile point stem.

The reed rear shaft measures 56.0 cm in length. It is 10.0 mm in diameter near the distal end and 6.0 mm in diameter near the nock. It is sinew-bound for a distance of 20.0 mm at the end containing the foreshaft. The nock is a shallow, wide, V-shaped cut at a joint where the reed is strongest. Immediately forward of the nock is a knob of sinew wrapping 10.0 mm long. Apparently it served the dual purpose of strengthening the nock and providing better purchase for the archer.

Fletching begins about 20.0 mm forward of the nock. The feathers were glued on with pitch and bound at each end with sinew. A single sinew strand was spiraled along the entire length of the feathers. The feathers are about 65.0 mm long.

The cane shaft is bound with sinew 80.0 mm forward of the feathers. The binding extends a distance of 9.0 mm. Total length of arrow is 70.0 cm. A nearly identical specimen was recovered from Stratum A of Wilson Butte Cave (Gruhn 1961:104, Plate 24a). The foreshaft is missing from this shaft but the only major difference appears to be its lack of the wrapped sinew knob between the nock and the bindings attaching the feathers.

Similar arrows were found in Level III of Pictograph Cave (Mulloy 1958:65–66, Figure 18, No. 1). One contained a nock that was placed 0.2 inch above a joint.

A cane mainshaft with a self nock was found in Layer DV of Danger Cave (Jennings 1957:189–190).

Another specimen consists of a foreshaft with attached projectile point and a short section of mid or rear shaft (Plate 48i). The foreshaft is *Salix* and measures 22.5 cm in length and 7.0 mm in diameter. The slotted distal end contains a Rose Spring Corner-Notched projectile point with sinew binding immediately below the point stem. The proximal end of the foreshaft is tapered and bears spiral rasp-like cuts identical to those on the foreshafts from Culture Layer 30. Some of the pitch used to secure the shaft in the socket remains.

The middle or rear shaft section is *Phragmites communis*. It measures 42.0 mm in length and 8.0 mm in diameter. The reed is bound at the distal end. Pitch was used under the binding. Apparently the binding was applied while the reed was green or wet because the binding has compressed the reed slightly. The broken arrow is 26.5 cm long.

A *Salix* rear shaft (Plate 48k) indicates that at least two kinds of arrows were made during Layer 36 times. This probably is part of a three-section compound arrow with reed main and wood foreshaft, although the entire arrow may have consisted of a single wooden shaft. The shaft is broken just forward of the sinew binding securing the distal end of the feathers. At this point the shaft is 7.5 mm in diameter. It tapers to a diameter of 5.5 mm immediately above the expanded nock. Diameter at the nock is 8.0 mm. The nock is a deep, wide, V-shaped groove 3.0 mm deep. The sinew feather bindings are 113.0 mm apart.

Like the two-piece arrow described above, sinew was spiraled around the entire length of the feather vanes. Length 17.5 cm. Similar arrowshaft fragments were recovered from Layer III of Pictograph Cave (Mulloy 1958:64) and Wilson Butte Cave Stratum A (Gruhn 1961:103); however, none had the expanded nock.

A *Salix* foreshaft (Plate 48j) is broken at the base of the slot that would have contained the projectile point. The shaft is 7.0 mm in diameter. The proximal end is tapered and spirally roughened with rasp-like cuts. If this roughening served to provide a tighter joint, the foreshaft would have been twisted clockwise when inserted into the middle or rear shaft. Length 21.4 cm.

Another foreshaft (Plate 48c) is represented by a distal fragment made from a solid piece of *Pinus*. It is 6.0 mm in diameter. The slot for the projectile point is 8.0 mm long and 1.0 mm wide. Length 90.0 mm. Two specimens of identical form were found in Stratum A of Wilson Butte Cave. They were called Notched Wooden Shafts (Gruhn 1961:103–104). One was identified as a mainshaft for wooden points (see “Foreshaft Slotting Discards” below) but obviously is a slotted foreshaft.

There is one tapered and spirally roughened proximal end of a foreshaft 7.0 mm in diameter at the break. Faint traces of pitch cement remain on the surface. Length 32.0 mm.

A section of arrowshaft (Plate 48d) bears fragments of three feathers bound with sinew. The feathers were all on one side or one half of the shaft and appear to have been tied on in a complete condition. The sinew binding is 14.0 mm long. Length 97.0 mm, diameter 7.0 mm.

Another shaft section (Plate 48e) is bound with sinew and contains pitch cement used to secure the feathers to the shaft. Sinew also was spiraled the entire length of the feathers. The imprint of this spiral binding shows on the shaft. Length 70.0 mm, diameter 6.5 mm.

A middle or rear shaft is represented by a distal end made of *Phragmites* (Plate 48a). It forms the socket into which the foreshaft was inserted. The end was roughened with longitudinal rows of short, parallel, oblique cuts. Pitch was then smeared over the end and the sinew binding applied. Contraction of the shaft beneath the binding suggests the reed was green or wet when the sinew was applied. Length 43.0 mm, diameter 9.0 mm.

A second but smaller and much lighter piece of *Phragmites* is bound with sinew (Plate 48b). It has been smashed flat. If part of an arrow, it was considerably smaller and lighter than others found in this stratum. Length of the sinew binding is 23.0 mm. Length 40.0 mm, width 8.0 mm.

**Arrowshaft Discard Sections** (12 specimens, Plate 48f–h, 1). Pieces of *Salix* twigs from which arrowshafts were cut. The desired length was determined, the twig was encircled by a V-shaped groove, and then the end was snapped off and discarded. Length 140.0 to 46.0 mm, diameter 6.5 to 8.0 mm.

**Foreshaft Slotting Discards** (five specimens, Plate 48p, q). Short sections of *Salix* scraps produced in slotting foreshafts to receive the projectile points. To form a slot, the shaft was measured to the desired length on a branch. Then the wood was notched on opposite sides at the desired point (primary notches). Then two smaller secondary notches were made at the desired distance from the primary notches but on the other two sides. The shaft was then bent back and forth splitting the wood from the two major notches down to the smaller secondary notches. The discard section was then broken out by bending the shaft at a right angle to the two splits. The procedure is illustrated by Cosgrove (1947:Figure 71a–e). Length 98.0 to 60.0 mm, diameter 7.0 to 6.0 mm, slot depths 9.0 to 8.0 mm. Similar specimens were recovered from Stratum A of Wilson Butte Cave but were identified as notched wooden points (Gruhn 1961:102, Plate 24). Two of these (Plate 24J, L) are pointed and might represent reworked proximal ends of foreshafts, particularly the specimen with six spiral cuts. All are 6.0 mm in diameter and would easily accommodate the small projectile points recovered from Stratum A. These objects most probably are shaft slotting discards rather than projectile points.

**Shaft Slotting Discards** (four specimens, Plate 48m–o). One may be scrap from construction of an arrowshaft (Plate 48m). The piece is purposely tapered from a roughly broken end to that containing the

slot plug. The latter end is 7.0 mm in diameter. This suggests that the shaft was tapered at both ends with the naturally thinner end at the nock.

The large broken end is slightly splintered, and some bits of mountain sheep hair are jammed beneath one of the larger splinters. Evidently the person making the shaft was wearing a mountain sheep skin garment or was working on a sheep skin robe. Length 11.8 cm, greatest diameter 12.0 mm.

Three specimens appear to be too large for arrowshafts. One of unidentified wood (Plate 48o) had been slotted previously. Apparently a shorter shaft was desired and it was re-slotted 50.0 mm below the original slot. The discard bears a slot and a slot plug. Length 67.0 mm, diameter 12.0 mm.

Another is a long, recurved limb of *Prunus melanocarpa* with a slot plug at one end and a splintered break at the other. The slot plug is 18.0 mm long. Length 20.3 cm, diameter 13.0 mm.

The third bears a slot plug at one end and was cut off at the other. Length 78.0 mm, diameter 12.0 mm.

**Tenoned Shaft Discard** (one specimen, Plate 49b). A smoothed tapered shaft cut off squarely at one end and with a tenon at the other end. It is the portion discarded after making a cylindrically mortised shaft. To form the mortise, a series of straight cuts were made encircling the wood. Then the discard section was bent, twisted, and pulled out of the main shaft. The tenon is 27.0 mm long and 5.0 mm in diameter. Length 16.7 cm, greatest diameter 10.0 mm, smallest diameter 8.0 mm.

**Reed Discards** (eight specimens, Plate 48r, s). Short sections of *Phragmites communis* raggedly broken at one end and evenly cut at the other. The reed was cut by making an encircling saw-like cut completely through the plant shaft. On one specimen the tiny encircling ridge at a joint has been chipped off (Plate 48r). On another there is one V-shaped cut between a joint and the cut end. One specimen is roughly broken at both ends. Length 75.0 to 12.0 mm, diameter 9.0 to 8.0 mm.

**Skewer or Awl?** (one specimen, Plate 49g). A long, tapered, pointed object possibly of *Prunus melanocarpa*. The tapered portion bears spiral cut marks. The overall surface has a somewhat polished appearance. The thicker end is rounded. Length 22.0 cm, diameter 7.0 mm. The implement is not a foreshaft and could be an awl, a skewer, or possibly a hairpin. The spiral rasping is like that observed on the tapered proximal ends of foreshafts. It has been suggested that this treatment might have served to better anchor the foreshaft in the mainshaft. A similar treatment on the specimen suggests that the spiral cutting may have been only a technique of tapering wood. I do favor the interpretation that rasping on foreshafts was an aid in anchoring.

**Awl Tip** (one specimen). Apparently this is the tip of a wooden awl. It is cylindrical in cross section and tapered to a point. Length 23.0 mm, diameter at break 3.0 mm.

**Fire Drill Tip** (one specimen, Plate 49d). A tapered torpedo-shaped fire drill tip with charred end. Evidently it was fitted into a mortised wooden shaft. The surface is covered with rough, rasp-like, slightly oblique cut marks. It is made of *Artemisia* sp. (sagebrush). Length 65.0 mm, diameter 10.0 mm.

**Knife Handle** (one specimen, Plate 49a). The distal end was slotted in the same manner as the arrow foreshafts described above. The handle tapers slightly from about the center to the rounded proximal end. The slot is 20.0 mm deep and 7.5 mm wide. The base of the slot was shaped to receive a concave based blade. Possibly it held a blade like the large corner-notched specimen described above.

The handle is decorated with four longitudinal rows of short, parallel, incised lines oriented transversely. There are eight to ten lines in each row. Length 15.0 cm, diameter 19.0 mm.

**Toy Bow** (one specimen, Plate 49h). Made of a twig of Douglas fir (*Pseudotsuga taxifolia*). One end was thinned by the removal of a few chips of wood. The bowstring is made of a single strand of twisted sagebrush bark (*Artemisia* sp.). Length 24.7 cm, diameter 8.0 to 6.0 mm. The tiny crudely made projectile points described above probably were part of the arrows used with this bow.

**Tenoned Stick** (one specimen, Plate 50j). A weakly curved peeled twig has a tenon at one end slightly smaller than the twig in diameter. The end of the tenon is raggedly broken; however, a blunt pro-

jection is rounded and smoothed. The tenon bears traces of a dark coating, probably cement, indicating that the twig had been inserted into a socket. The tenon is 53.0 mm long and 5.0 mm in diameter. The other end had been cut but is now slightly rounded and frayed. Rounding of the cut end was caused by some undetermined use. Length 19.0 cm, diameter 8.0 mm; *Salix* sp.

**Knobbed Sticks** (two specimens, Plate 50a, b). These were thinned near one end to form a subdued hook-like knob. The larger utilizes the raised node where a twig branched from the larger unit. The stick was cut off immediately beyond the node. This end is rounded and somewhat smoothed from use. Immediately below the node is a shallow concave area 30.0 mm long formed by many parallel-oblique rasp-like cuts. Several other branches were cut or broken off and the nodes lightly smoothed. The side bearing the whittled area exhibits random battered and cut areas. The other end is broken and split. Length, 21.0 cm, diameter 11.0 mm; chokecherry (*Prunus melanocarpa*).

The smaller is similar in construction but does not have a node at the thinned end. It was merely cut transversely 10.0 mm from the end and whittled for a distance of 18.0 mm below the cut forming a low lateral knob. The end above the knob was cut transversely and broken off. The opposite side was flattened by parallel-oblique rasp-like cuts. The unworked end is broken and frayed. Length 11.0 cm, diameter 8.0 mm; *Prunus melanocarpa* (chokecherry). The use of these implements is conjectural. They might be lifting devices similar to a pot hook or possibly they could be parts of trap triggering mechanisms.

**Trap or Snare Parts?** (two specimens, Plate 49c). One is a short cylindrical length of stick tied within the central portion of a long length of two-ply S-twist *Yucca* cordage. The stick was cut by encircling grooves at both ends. The portions to be discarded were then snapped off. One side bears diagonal rasp-like cuts and one end is slightly and roughly tapered.

The cord is looped around the stick five times at each end. There is an overhand knot at one end of the cord. The other end is broken and frayed. The cord is made up of two lengths of different diameters spliced together. Stick length 48.0 mm, diameter 6.0 mm, cord length 68.0 cm, diameter 4.0 and 2.0 mm.

A similar object consists of a short section of twig with a length of two-ply S-twist cordage looped around it eight times. The twig is cut at one end and broken at the other. Length of twig 20.0 mm, diameter of twig 4.0 mm, diameter of cord 1.5 mm.

**Smoothed Stick** (one specimen, Plate 49e). A short section of twig with smoothed, rounded ends. The surfaces, except for one side, bear many tiny shallow dents where the surface has been depressed. Its use is unknown. Length 58.0 mm, diameter 8.0 mm.

**Whittled Stick** (one specimen, Plate 49f). A curved branch or twig split from two directions. The two split faces and edges were whittled by diagonal rasp-like cuts. One end was cut by completely encircling the wood and snapping it off. The other end is tapered to a blunt point and somewhat smoothed. This end is lightly scarred. Length 12.0 cm., width 10.0 mm, thickness 8.0 mm; *Artemisia* sp. (sagebrush).

**Ends of Digging Sticks?** (two specimens, Plate 51d, e). One (Plate 51e) is a tapered piece of wood, oval in cross section, with a worn rounded end. It is broken at the other end. Length 95.0 mm, width 30.0 mm, thickness 16.0 mm.

The other (Plate 51d) is a split slat-like piece of wood with one rounded, smoothed end. This end is slightly charred and may have been fire hardened. The other end is broken. Length 11.5 cm., width 25.0 mm, thickness 8.0 mm; *Pinus*?

**Cut and Split Wood** (one specimen, Plate 51a). A long narrow piece of wood split from a branch. One end was sawed off transversely. Another transverse cut was made 60.0 mm from this end. It penetrated about half way through the wood. Then the wood between the cut and the end was split away. The sawed end is lightly frayed at the edges indicating use, probably in scraping. The other end is broken and split. Length 29.0 cm, width 19.0 mm, thickness 12.0 mm; *Prunus melanocarpa* (chokecherry).

**Curved Sticks** (two specimens, Plate 50h). Two sticks, broken at both ends, and purposely curved. Both are lightly dented and scratched. They appear to be parts of some constructed object, possibly a cradleboard. Length 30.0 and 26.0 cm. diameter 9.0 mm.

**U-Shaped Stick** (one specimen, Plate 57a). A twig bent into a U-shape. It was recovered from the foot portion of the nearly completely deteriorated boot described below. It appears to have served to retain the shape of the boot while being dried or cached. Length of twig 45.0 cm, diameter 8.0 mm, length of curved twig, 18.3 cm, width 11.0 cm; *Amelanchier* sp.

**Cut and Blunted Wood** (one specimen). A section of large unpeeled limb pointed by making several oblique cuts. The point is rounded from use. Soil is encrusted on the point suggesting it may have been used in digging. The other end is broken and split. Length 18.5 cm, diameter 22.0 mm; *Prunus melanocarpa* (chokecherry).

**Notched Twig** (one specimen). A short section of twig severed at one end by sawing part way through and snapping in half. The other end was similarly cut. Then a second cut was made about 10.0 mm from the end. The wood between the cut and the end was then split away. The split surface appears to have been somewhat smoothed or possibly utilized for some undetermined purpose. Length 40.0 mm, diameter 12.0 mm.

**Cordage-Wrapped Twig** (one specimen). A length of twig wrapped with several turns of large diameter, loosely twisted, two-ply S-twist cordage. The cordage is tied with a large, complex knot. The twig is broken at both ends and bears no evidence of modification beyond removal of the bark. Length of twig 96.0 mm, diameter of twig 10.0 mm, diameter of cord 5.0 mm; twig *Prunus Melanocarpa* (chokecherry), cordage *Artemisia* (sagebrush) bark.

**Bark-Wrapped Twig** (two specimens, Plate 56d, e). One (Plate 56d) is a short section of twig, broken at both ends, with a strip of bark loosely wrapped twice around one end. Twig length 94.0 mm, twig diameter 11.0 mm, bark strip width 11.0 mm; *Salix* sp.

The other (Plate 56e) is a curved twig with a strip of bark wrapped around its center. Twig length 190.0 mm, twig diameter 6.0 mm; twig and bark strip; *Prunus melanocarpa* (chokecherry).

**Cut Wood** (26 specimens, Plate 50c–g, Plate 51b, c). Several methods of cutting twigs and branches were employed. A group of 12 twigs have a V-shaped notch at one end formed by two opposing diagonal cuts (Plate 50c–f). The other end is cut off diagonally. The wood was cut green with a very sharp instrument, probably a flake, because the cuts are very clean and only a few strokes were necessary to sever the twigs. Some twigs were peeled entirely, some were half peeled, and some were left unpeeled. The ends are split but this appears to have been caused by drying. These objects show no obvious evidence of use and apparently represent discarded scrap. Length 22.0 to 11.3 cm, diameter 10.0 to 6.0 mm; *Prunus melanocarpa* (seven), *Salix* sp. (five).

Eight twigs and branches were cut at one or both ends by completely encircling the wood with a groove and then snapping it in two (Plate 51b, c). Length 23.0 to 6.5 cm, diameter 26.0 to 8.0 mm; *Prunus melanocarpa* (five), *Salix* sp. (two), *Pinus* (one).

Five twigs or branches were cut by making two opposing saw-like cuts, each about one-third the thickness in depth. Then the wood was broken. Two specimens (Plate 50g) are roughly beveled on the opposite end. Both bear spiral cuts on the beveled portion. Length 13.5 to 6.0 cm, diameter 17.0 to 13.0 mm; *Prunus melanocarpa*.

One twig was cut by making several sharply diagonal cuts around the circumference with a sharp instrument such as a flake (Plate 50i). The other end is broken and finely split. Length 15.0 cm, diameter 8.0 mm; *Prunus melanocarpa*.

Another twig was cut off at a moderately shallow angle with a sharp instrument while green. The other end is charred and rounded. Length 11.5 cm, diameter 11.0 mm; *Prunus melanocarpa*.

A section of split branch is cut off at one end and roughly broken at the other. The cut was made from the split surface penetrating about half way through the wood. The end was then snapped off. A diagonal cut was made on the outer surface at the broken end. It extends from the end diagonally toward one edge and is one-third the thickness in depth. The wood beyond the cut is missing. Length 70.0 mm, width 23.0 mm, thickness 10.0 mm; *Prunus melanocarpa*.

**Broken Twigs** (three specimens). Sections of twigs simply broken off at each end. One is charred at one end and may be only a piece of firewood. The other two may be pieces discarded in arrow making. Length 170.0 to 90.0 mm, diameter 11.0 to 6.0 mm; the two of smaller diameter are *Salix* sp.

**Burned Wood** (one specimen). At first glance this appears to be a hearth from a fire making kit. However, the semicircular hole on one side is merely the point at which a branch diverged from the limb - a knothole. The piece of wood appears to be unburned firewood. Length 10.8 cm, width 17.0 mm, thickness 16.0 mm.

**Basketry Splints** (one specimen, Plate 56a). A bundle of split twigs apparently for the stitching in coiled basketry. The splints are thin, the result of multiple splitting of individual twigs. Length 30.0 to 20.0 cm, width 2.0 to 3.0 mm; *Salix*.

### **Bark and Grass**

**Coiled Basketry** (10 specimens, Plate 52a–e). All basketry from Culture Layer 36 is represented by badly deteriorated fragments from at least three different containers. It is uniform in method of construction, differing only in the element size and the presence or absence of an interior coating.

The basketry is close coiled and constructed on a single split rod foundation. Apparently the rods were peeled. The stitches are interlocking and range from five to nine per inch. There are from six to eight rods per inch. One center fragment is coiled clockwise, as viewed from the exterior surface. Four fragments have a coating of pitch on the interior indicating use as containers for liquids.

**Cordage** (136 specimens, Plate 53b–j). Cordage from Culture Layer 36 consists mainly of twine or a string of small diameter. There are three fragments of netting (Plate 53g, j), and several specimens are parts of artifacts described elsewhere. Also included here are 14 pieces of sinew cord or thread. Three of these have been twisted tightly at one end.

Of the 122 specimens of plant fibers, 111 are twisted and 11 specimens consist of one-ply untwisted roving. The direction of twist by element is provided in Table 7.

Sagebrush bark, yucca, and Indian hemp were the most frequently used fibers for cordage; however, six other plant fibers and sinew were utilized. The materials used are listed in Table 8.

The hardness of twist was determined for 104 specimens by measuring the helix angle (Osborne and Osborne 1954:1098–1099). More than half of the cordage is of hard twist and about one-third is a medium twist. The degree of twist is given in Table 9.

Approximately two-thirds or 87 of 131 measurable specimens are between 2.0 and 4.0 mm in diameter. Of the remainder, 21 are from 1.0 to 1.5 mm in diameter, 22 measure from 5.0 to 6.0 mm in diameter and one is 9.0 mm in diameter.

Nine kinds of knots were identified. These are listed in Table 10.

**Brush** (one specimen, Plate 53a). A long narrow brush made of one bundle of grass with another bundle folded around one end and tied with a length of two-ply S-twist *Yucca* cordage. The cord is knotted with a double half hitch. Length 115.0 mm, width 23.0 mm, thickness 16.0 mm.

**Moccasin Liners** (two specimens, Plate 54c). These are flat oval pads of grass apparently used to line moccasins or the boot to be described below. Both are matted and muddy. Length 25.0 and 21.0 cm, width 9.0 and 8.5 cm, thickness 1.5 and 2.4 cm, respectively.

Table 7. Direction of twist by element.

Twist	Count
2-Ply, S-Twist .....	75
2-Ply, Z-Twist .....	28
3-Ply, Z-Twist .....	2
4-Ply, S-Twist .....	1
1-Ply, Z-Twist .....	13
1-Ply, Roving .....	11
<b>Total</b>	<b>136</b>

Table 8. Materials used in the manufacture of cordage.

Material	Count
<i>Artemisia</i> , sagebrush bark .....	51
<i>Yucca</i> .....	31
<i>Apocynum</i> .....	26
Sinew .....	14
<i>Juncus</i> or <i>Phragmites</i> .....	4
<i>Salix</i> , willow bark .....	11
<i>Juniperus</i> , juniper bark .....	1
grass leaves .....	1
<i>Populus</i> or <i>Alnus</i> .....	1
xerophytic plant, unidentified .....	1
other unidentified .....	4
<b>Total</b>	<b>136</b>

**Bark Bundles** (nine specimens, Plate 54a, d, e; Plate 55b, c; Plate 56b, d). These are bundles of various tree and plant barks evidently for use in constructing implements. One (Plate 54e) appears to have been wrapped around a tapering object of oval cross section; *Prunus melanocarpa* (four), *Artemisia* (three), *Juniperus* (one).

**Bark Strip** (one specimen). A narrow length of slightly twisted bark bearing no evidence of use. Apparently it was collected for future use, possibly in making cordage. Length 32.0 cm, width 11.0 mm; *Artemisia*.

**Knotted Bark Strips** (20 specimens, Plate 54b; Plate 55a, Plate 56c, f). Strips of bark containing one or more knots and looped and knotted strips of bark. Some appear to be raw material and others appear to be cords used to tie bundles of other materials; *Artemisia* (15), *Prunus melanocarpa* (two), *Juniperus* (two), unidentified (one).

**Bark** (one specimen). A small irregularly shaped piece of bark with small dot-like hematite stains scattered over both faces and around the edges. The hematite does not appear to have been purposely applied. Length 28.0 mm, width 25.0 mm, thickness 8.0 mm.

Table 9. Helix angles of cordage other than one-ply roving.

Twist Type	Soft 10–20°	Medium 21–30°	Hard 31–50°	Very Hard 51–70°
2-Ply, S-Twist	7	18	47	1
2-Ply, Z-Twist	2	13	11	2
3-Ply, Z-Twist	—	—	2	—
4-Ply, S-Twist	—	—	1	—
<b>Total</b>	<b>9</b>	<b>31</b>	<b>61</b>	<b>3</b>



## Hide and Hair

**Boot or Moccasin** (one specimen, Plate 57b). This specimen, along with the nearly completely deteriorated other half of the pair, was cached beneath a grinding stone. The U-shaped stick shown in Plate 57a had been inserted into the foot of the deteriorated boot. The stick probably served to retain the shape of the boot during storage.

The better-preserved boot is made of mountain sheep hide with hair intact. The foot portion is made of four pieces of hide sewn longitudinally with a running stitch. There are seams along both edges and down the center of the sole and body. The edge and sole seams were sewn first on the interior side. Then the longitudinal body seam was sewn from the outside.

The legging portion consists of pieces of hide folded so that the hair is present on both the inner and outer surfaces. The pieces were joined with an overhand stitch. The upper edge is represented by a fold on one side, but the other side was considerably higher. This side is deteriorated and its actual height is undetermined.

The specimen appears to be a winter boot for use in snow and probably served the same purpose as the Eskimo mukluk. The seam down the center of the sole would be uncomfortable on hard ground. Some of the grass liners may have been used with the boot.

**Sewn Hide** (three specimens, Plate 58a, c). One piece of mountain sheep hide and two of bison are perforated, and sections of sinew thread remain in some of the holes. Hair remains on all three specimens.

The piece of mountain sheep skin has a smaller piece of the same material attached by sinew thread. The interior surface of the larger piece is of a rust color and appears to have had a pigment (hematite?) rubbed into the surface.

All three appear to be discarded scraps or parts of worn apparel. The piece of sheep hide appears to be a remnant cut from a larger section, possibly in preparation for patching. Length 120.0 to 80.0 mm, width 100.0 to 40.0 mm.

**Perforated Hide** (five specimens, Plate 58b, d, g). Four pieces of unidentified tanned animal skin have one or more short slit-like perforations probably for sewing. Another long narrow piece of skin has a long wide perforation subsequently stretched by pulling longitudinally to the long axis. There is a second similar perforation along one edge 25 mm from the end of the other hole. The five appear to be discarded scraps. Length 165.0 to 43.0 mm, width 80.0 to 25.0 mm.

**Cut Hide** (11 specimens, Plate 58e, h). Ten are pieces of mountain sheep hide and one is a piece of unidentified animal skin with neatly cut edges. The hair remains on the mountain sheep specimens. All seem to be scraps left over from the shaping of larger pieces. Length 180.0 to 18.0 mm, width 45.0 to 17.0 mm.

**Dyed Hair** (six specimens). Small tufts of mountain sheep hair light red in color. The hair is attached to small bits of hide up to 10.0 mm in length.

**Thong** (three specimens, Plate 59f–h). Narrow to wide strips of animal skin apparently used as straps, cordage, or thongs. One has an overhand knot near one end. Length 130.0 to 45.0 mm, width 6.5 to 2.0 mm.

Table 10. Identified knots.

Knot	Count
Overhand, Left .....	26
Overhand, Right.....	12
Overhand Slip.....	2
Overhand Slip, right.....	1
Netting Knot.....	11
Double Half Hitch.....	8
Granny.....	4
Clove Hitch .....	3
Square .....	3
Bowline .....	1
Half Hitch.....	1
Undetermined, Complex .....	1
<b>Total</b>	<b>73</b>

**Fur Cloth** (two specimens, Plate 58f). Single strands of twisted rabbit fur strips apparently from a fur cloth robe. Both are very tightly twisted. Length 105.0 and 95.0 mm.

**Animal Hide** (two specimens). Two small pieces of deteriorated unidentified animal hide.

**Animal Hair** (13 specimens). These are tufts or wads of hair and tiny bits of skin with the hair adhering. Seven are of mountain sheep, four of bison, and two of deer.

#### **Sinew**

**Arrow Binding** (one specimen, Plate 59e). A band of fine coiled sinew apparently used to bind an arrowshaft or to hold the feathers in place. Inside diameter 5.0 mm, length 4.5 mm.

#### **Feathers**

**Trimmed Feathers** (three specimens, Plate 59b, c). One (Plate 59c) has a continuous series of notch-like cuts along one side as if cut with pinking shears. At the distal end is a short projection with similar cuts on both edges. Length 100.0 mm.

Two others are cut transversely near the midpoint (Plate 59b). Length 99.0 and 73.0 mm.

**Cut Feather Shafts** (three specimens, Plate 59a). Discarded pieces produced while trimming feathers for fletching arrows. The shafts were cut about half way through near the proximal end. Then the shaft was split leaving the discarded section. Length 100.0 to 87.0 mm.

**Feathers** (five specimens, Plate 59d). Apparently unaltered feathers from unidentified birds. Length 179.0 to 74.0 mm.

**Feather Shaft** (one specimen). This is the shaft of a feather from a large unidentified bird. Length 198.0 mm.

#### **Fish Parts**

There were many small fragments of bone and scales from unidentified fish.

## **CULTURE LAYER 37**

### ***Features***

Edgar stated that evidence of fires in this level consisted of small, thin, circular areas of ash and charcoal.

### ***Artifacts***

#### **Chipped Stone**

**Side-Notched, Straight or Concave Base** (nine specimens, Plate 60k–s). Somewhat crude projectile points with weakly convex lateral edges and straight or shallowly concave bases. The side notches range from narrow to extremely wide and are placed low on the edges close to the base. On all but one the stems are equal to or only slightly less than the greatest width. One stem is considerably narrower. Flaking is poorly executed and there is no edge retouching. Cross sections range from plano-convex to biconvex. Length 33.0 to 19.0 mm, width 14.0 to 10.5 mm, thickness 3.5 to 2.5 mm; chert (nine).

**Side-Notched, Convex Base** (one specimen, Plate 60j). A crudely fashioned projectile point with straight lateral edges and an asymmetric convex base. The side notches are deep and wide and placed immediately above the base. Chipping is extremely poor with no retouching of the edges. The cross section is roughly plano-convex. Length 27.0 mm (estimated), width 13.0 mm, thickness 3.5 mm; fossil wood.

**Triangular** (two specimens, Plate 60t, u). These two projectile points have straight to convex lateral edges and slightly concave bases. Flaking is rough producing ragged but not serrated lateral edges and

bases. There is no retouching. Cross sections are biconvex. Length 45.0 (estimated) and 28.0 mm (estimated), width 16.0 and 15.0 mm, thickness 4.5 and 3.0 mm, respectively; chert (two).

**Miscellaneous** (one specimen). A triangular distal portion of a point. It is finely flaked and retouched. The cross section is biconvex. It is made of fossil wood.

**Modified Flake** (one specimen, Plate 60v). A pentagonal flake with a medium high-angle unifacially chipped scraping edge along one side. This edge shows slight evidence of use. The opposing edge is chipped and scarred from use. It is not intentionally modified. One end is broken. Length 51.0 mm, width 37.0 mm, thickness 8.0 mm; chert.

## CULTURE LAYER 38

### *Features*

This thin layer also contained an unknown number of circular areas of ash and charcoal from small fires. No data concerning them was recorded.

### *Artifacts*

#### **Chipped Stone**

##### **Projectile Points**

**Triangular, Side- and Base-Notched** (six specimens, Plate 60a–e). Small triangular projectile points with straight to slightly convex lateral edges and weakly concave bases. The side notches are transversely placed a minimum of 4.0 mm above the base. The basal notches range from shallow to deep and are placed at or near the centerline. Cross sections are lenticular but thickness is variable. One specimen is made on a thin, plano-convex flake. Chipping ranges from good to mediocre and the edges are retouched. Length 30.0 to 23.0 mm, width 15.0 to 13.0 mm, thickness 4.5 to 3.0 mm; obsidian (three), chert (two), chalcedony (one).

**Triangular, Side-Notched** (five specimens, Plate 60f, g). With the exception of lacking a basal notch, these items are identical to the triangular side- and base-notched category of projectile points. Length 29.0 to 22.0 mm, width 15.0 to 11.0 mm, thickness 3.5 to 2.5 mm; obsidian (three), chalcedony (one), quartzite (one).

**Fine Triangular** (one specimen, Plate 60h). A small triangular point with weakly convex lateral edges and a straight base. It is lenticular in cross section and well flaked. The basal edge is longitudinally thinned. Length 21.0 mm, width 14.0 mm, thickness 3.0 mm; chert.

**Crude Triangular** (one specimen, Plate 60i). The proximal half of a triangular point with convex lateral edges and a slightly concave base. It is widest a short distance above the base. The specimen is made on a curved plano-convex flake and is flaked only on the periphery of the planar face. The convex face exhibits good overall chipping. Length undetermined, width 16.5 mm, thickness 3.0 mm; chert.

**Miscellaneous** (one specimen). Either a triangular side-notched, or side- and base-notched point. The tip and one basal corner are missing. In form and workmanship it is identical to the above two side-notched categories. Length 30.0 mm (estimated), width 13.0 mm, thickness 3.5 mm; quartzite.

##### **End Scrapers**

**Trianguloid** (one specimen, Plate 60w). A small, well-made, plano-convex end scraper with a high-angle bit. The scraping edge is semicircular and the lateral edges are nearly straight. The proximal end is irregularly convex. The dorsal surface is flaked overall except for areas of cortex. A few flakes were removed from the bulb of percussion at the proximal end of the ventral surface. The scraping edge is chipped and scarred from use. It was resharpened by minute pressure flaking. There is a short, wide, tri-

angular spur at one side of the bit. The tip is blunt and slightly smoothed. Use flake scars are apparent on both the dorsal and ventral surfaces. Length 31.0 mm, width 26.0 mm, thickness 6.0 mm; chalcedony.

**Ovate** (one specimen, Plate 60x). A roughly made ovate high-angle end scraper made on a thick blade-like flake. The scraping edge is irregularly semicircular. The middle portion is severely chipped and scarred from use. The lateral edges are haphazardly retouched. The dorsal surface bears one long, wide, longitudinal flake scar. One side consists of pebble cortex. The ventral surface bears thinning flake scars at the proximal end. The cross section is trapezoidal. Length 36.0 mm, width 29.0 mm, thickness 8.0 mm; chalcedony.

## **Clay**

**Pottery** (47 specimens, Plate 61a–d). Forty-seven sherds, all apparently from a single vessel. There are four rim sherds, one basal sherd and 42 body sherds. Less than one-quarter of the vessel is represented; however, enough sherds connect to provide an accurate reconstruction of vessel form.

**Method of Manufacture:** Apparently the vessel was lump-modeled and finished with a paddle.

**Temper:** Tempering is very scarce and consists of occasional quartz sand grains less than 1.0 mm to at least 3.0 mm in diameter.

**Texture:** The paste is compact but laminated. The sherds have a tendency to split parallel to the walls. Sherd edges are rough but do not crumble easily.

**Hardness:** Exterior surfaces are harder than 2.5 but softer than 3.0.

**Color:** Surface color ranges from black through gray to light buff. Interiors are uniformly black to dark gray.

**Surface Finish:** When viewed in profile, the exterior surface has a wave-like appearance with the crests apparently encircling the vessel in horizontal bands. The vessel may have been coiled although lump modeling is also suggested. The surface is smooth with the exception of small rough pits and low spots. Some areas are highly polished. Random striations occur here and there on the surface.

The interior is much like the outer surface but lacks the undulating wave-like appearance. It is smoothed but pitted and is randomly striated. One sherd bears a thick carbonaceous deposit.

**Lip:** The lip is slightly rounded with a definite angularity at the lip body wall juncture on both the interior and exterior surfaces. The lip averages 5.0 mm in thickness.

**Body:** The vessel is shaped much like a goblet but with a thick stem. The base is only slightly larger than the stem. The projected arc of one large sherd suggests a vessel with a maximum diameter of 25.0 cm. It probably was about 25.0 cm high. The base is about 12.0 cm in diameter. The greatest diameter is 4.0 cm below the lip, and the smallest diameter is the same distance above the base. Wall thickness ranges from 9.0 to 5.0 mm and averages approximately 7.5 mm. There is a considerable thickening at the base body juncture where one sherd is 12.0 mm thick.

**Base:** The base is flat and joins the body in a smooth curve. The basal flange, often found on this type of pottery, is weakly developed.

## UNKNOWN PROVENIENCE

### *Artifacts, Chipped Stone*

#### **Projectile Points**

**Lanceolate, Narrow, Concave Base** (one specimen, Plate 8t). Identical to the major projectile point type in Culture Layer 10. It is quite thick and has a rounded median ridge on one face. The complete specimen must have been at least 60.0 to 65.0 mm long and 18.0 to 20.0 mm wide. The basal fragment is 9.0 mm thick; chert. This specimen was recovered from disturbed fill resulting from the slumping of a partial excavation unit at the rear wall. The slump occurred below Culture Layer 16.

**Lanceolate, Narrow, Straight Base** (one specimen, Plate 8v). A basal fragment with straight edges diverging from a narrow straight base. It is biconvex in cross section. Chipping is fair and the lateral edges are smoothed. Length is estimated to have been about 60.0 mm. It probably was at least 20.0 mm wide. The fragment is 7.0 mm thick; chert. The specimen was recovered from a small area where Culture Layers 10 and 11 merged, and it is unknown which layer contained the projectile point.

**Rectangular Stem, Concave Base** (one specimen). This broken point has weakly convex lateral edges and a parallel-edged stem with a slightly concave base. Deep notches extend obliquely toward the tip from the base forming the stem and shoulders. Flaking is poorly controlled, but the edges are retouched. The cross section is thin and biconvex. Length 32.0 mm (estimated), width 26.0 mm (estimated), thickness 4.0 mm; chert. The specimen was found on the working floor after removal of Culture Layers 28 through 24. It could have come from any of these levels; however, similarities to specimens in Culture Layer 28 suggest it may have originated in this stratum.

## Chapter IX: Comparisons

As might be anticipated, the excavation of Mummy Cave, located in a district that has received little or no archeological investigation, produced some assemblages representative of cultural phases previously unknown, or for which only a small amount of information is available. In view of the evidence from the shelter and recently acquired data from elsewhere in the Rocky Mountains, current thinking on some aspects of western American prehistory is in need of revision.

Chipped-stone implements, projectile points in particular, have been used in establishing temporal and cultural relationships. In certain instances, artifacts or other materials and particular kinds of fire pits can be used in determining relationships between assemblages through time. However, in the west, the projectile point is the only diagnostic that can be used consistently for comparative and chronological purposes during the long period preceding the introduction of pottery.

Evidence from Mummy Cave clearly demonstrates that projectile point form changed with time, and that changes occurred rapidly enough to permit the drawing of certain conclusions. It was also apparent that, in most instances, replacement was essentially total, with little or no persistence of distinctive forms appearing in succeeding levels. Such changes were demonstrated earlier at sites such as Pictograph Cave (Mulloy 1958), Signal Butte (Strong 1936), Wedding of the Waters Cave (Frison 1962), and the Bighorn Canyon rockshelters (Husted 1969). While all of these sites are on the western Plains or on the Plains-Rocky Mountain border, it is believed that such indications of cultural change are not limited to the Plains and that similar changes took place throughout the western United States during the entire period of human occupation. Changes in point form may have been slower during one period than in another, but they did occur, and are indicative of significant events in the past. In his monograph on the investigations at Danger Cave, Jennings (1957:265) states:

... the archaeologist's universal assumption — that typological identity between specimens implies either direct or indirect cultural contact or chronological equivalence — is only an assumption.

This statement is of critical importance to western American prehistory. A modified version of Jennings' statement is here accepted as an operational principal and forms the basis of the comparisons to follow. It is accepted that typological identity between certain specimens is indicative of a cultural relationship and chronological equivalence. Furthermore, typological similarity between specimens may indicate a cultural relationship (close or remote) or, in certain instances, cultural contact. A survey of the literature on western archeology reveals that a majority of students accept typological identity as an indicator of approximate chronological equivalence whether explicitly stated or not. Apparently, others also accept identity as an indicator of cultural relationship. In an area where identical or very similar styles of specific artifacts occur over large expanses, such as in the west, it would seem that identity of specimens may or may not imply cultural contact or relationship and contemporaneity. The question of which alternative is valid remains open. Only additional evidence will resolve this problem, and the data from Mummy Cave and its interpretation are offered here in support of the affirmative.

### LAYER 1 COMPARISONS

The first seven occupation levels produced very little evidence for comparative purposes. Only three of these strata produced an identifiable artifact, and at present only the projectile point from Culture Layer 4 seems to have possible diagnostic value. Unfortunately its association with Layer 4 is questionable. The prismatic blade recovered in Culture Layer 1 is of little comparative use without additional diagnostic artifacts. Blades of this type are known to occur in the Llano, Folsom, and Agate Basin complexes (Green 1963:162) and later assemblages. Lacking any other evidence, all that can be said for Culture Layer 1 is that it contained a blade estimated to date around 7500 BC.

## LAYER 4 COMPARISONS

The projectile point in Layer 4 most closely resembles specimens found in two rockshelters in Big Horn Canyon. Here, the Lovell Constricted point (Husted 1969) is lanceolate, has constrictions of the lateral edges near the concave base and is obliquely flaked (Husted 1965:Fig. 1g, h). Two specimens from Occupation II of the Sorenson site were collected from fire pits also producing charcoal dated at  $7800 \pm 250$  BP (I-612) and  $7560 \pm 250$  BP (I-689). Examples were recovered from the lowest occupation level of Bottleneck Cave dated at  $8270 \pm 180$  BP (SI-237) (Long and Mielke 1967:374). The specimen bears a resemblance to the Allen point (Mulloy 1959), but its closest ties seem to be with the Lovell Constricted point.<sup>4</sup> No other diagnostic artifacts were recovered from the stratum.

## LAYER 6 COMPARISONS

Diagnostic implements were lacking in Layer 6. The graver made on the broken projectile point is obliquely flaked, a trait that has possible diagnostic value. The basin and bowl-shaped fire pits are identical to those in succeeding levels and those in three rockshelters in Big Horn Canyon. Bowl-shaped pits in the lowest level of the Mangus site are dated at  $8690 \pm 100$  BP (SI-98) and  $8600 \pm 100$  BP (SI-101) (Long 1965:249). One from the lowest level of Sorenson is dated at  $7960 \pm 150$  BP (SI-308) (Long and Mielke 1967:371). The above mentioned fire pits from Occupation II of Sorenson and Occupation I of Bottleneck Cave are identical. The two next higher layers of Bottleneck Cave contained bowl-shaped fire pits. Occupation II is dated at  $8210 \pm 200$  BP (SI-236) and Occupation III has dates of  $8160 \pm 180$  BP (SI-240) and  $8040 \pm 220$  BP (SI-241) (Long and Mielke 1967:372).

## LAYER 8 COMPARISONS

Beginning with Culture Layer 8, more confidence can be placed in comparisons with material found elsewhere in the Rocky Mountains. The major category of projectile points from Culture Layers 8–12 conforms to the description of the Angostura point as defined by Wheeler (1957, 1995). A point with oblique flaking was found in the Johnson Park Reservoir site in western Idaho (Caywood 1948:Fig. 51). However, this specimen is weakly shouldered, and I would not place it in the Angostura category.

Wheeler refers to an obliquely flaked point from Kotzebue, Alaska (1957:541). This specimen is a distal fragment and cannot be identified as to type (Giddings 1948:127, Fig. 22). Since the time Wheeler's manuscript was prepared, other types or varieties of obliquely flaked projectile points have been recognized including the Allen point (Mulloy 1959), the Frederick point (Agogino, Rovner, and Irwin-Williams 1964), Lovell Constricted, and Pryor Stemmed points (Husted 1969). Oblique flaking is exhibited on artifacts of the Denbigh Flint complex of Alaska (Wormington 1957:Figs. 60 and 61). Without the basal portion, the typing of obliquely flaked points is tenuous at best.

A small point from Stratum 5 (Portales horizon) of the Blackwater No. 1 locality in New Mexico is considered to be an Angostura point (Wheeler 1957:539). It may be; however, considering the other points from this level, the cited specimen (Sellards 1952:Fig. 36e) is unique and would seem to be a variant of one of the other forms of which there are numerous examples (Sellards 1952:Figs. 35–37).

Other specimens mentioned by Wheeler (1957) appear more likely to be Angostura points. A point found near Glenns Ferry, Idaho, fits the Angostura description (Kehoe 1955:Fig. 4a). Several specimens collected from the surface on the Oscar Lewis ranch south of Glendive, Montana, appear to be Angostura points (Mulloy and Lewis 1943:Fig. 28, 1–9).

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<sup>4</sup> *Senior Author's Note:* The projectile point from Culture Layer 4 is neither a Lovell Constricted point nor an Allen point. A nearly identical specimen was recovered at the Medicine Lodge Creek site from a stratum dated by radiocarbon between  $9360 \pm 380$  BP and  $9510 \pm 260$  BP (Frison 1991:Table 2.5, Fig. 2.33).

Finds since the time of Wheeler's investigations provide additional distributional data. Occupations 1 and 2 of the Pine Spring site in southwestern Wyoming contained several examples of what appear to be Angostura points (Sharrock 1966:Figs. 35a, b, d, i, o).

Points from sites 10BT62 and 10CL100 in the Birch Creek Valley of eastern Idaho are comparable but were identified as Plainview Lanceolate (Swanson, Butler, and Bonnicksen 1964:Fig. 36hh). Identical specimens, termed Broad Lanceolate, were recovered from surface sites in southwestern Idaho (Swanson, Powers, and Bryan 1964:Fig. 4 ww-yy). At least one example was found on the surface in Craters of the Moon National Monument in Idaho (Sneed 1967:Fig. 4, No. 5). Two similar specimens were collected from two sites in southern Idaho (Swanson, Tuohy, and Bryan 1959:74, No. 13).

At least two examples were found at the Carbella site (24PA302) on the Yellowstone River north of Yellowstone National Park (Arthur 1966:Fig. 17c, e).

Several Angostura points were collected from a site in the northern Black Hills (Gant 1961:Fig. 1a-d).

### LAYER 9 COMPARISONS

The base of what appears to be an Agate Basin point came from Culture Layer 9. This type is found over a wide area in the western Plains and westward through Idaho into Oregon and Washington. Two Agate Basin strata were revealed at the Brewster site (Agogino and Frankforter 1960:104). The lower component is dated at  $9990 \pm 225$  BP (M-1131) and the upper at  $9350 \pm 450$  BP (O-1252) (Crane and Griffin 1963:224). Two radiocarbon dates from a stratum overlying that producing Agate Basin points indicate that the Agate Basin occupation of the Blackwater No. 1 Locality, New Mexico, took place before about 10,500 BP. The dates, from Unit D2, are  $10,200 \pm 250$  BP (A-488) and  $10,490 \pm 200$  BP (A-492) (Haynes, Damon, and Grey 1966:14).

At least one Agate Basin point as well as Hell Gap and concave base points were recovered at the Lind Coulee site in Washington (Daugherty 1956:Figs. 19, 20). The occupation has two radiocarbon dates,  $9400 \pm 940$  BP and  $8518 \pm 460$  BP. The average of these two is  $8700 \pm 400$  BP (C-827) (Libby 1955:121).

Agate Basin, Hell Gap, and possibly Alberta points were found in the lower zones of Cougar Mountain Cave in south-central Oregon (Cowles 1959: Pls. 1-3, 6). As at Lind Coulee, a few concave base points were present. A sandal fragment from near the top of the earliest occupation layer gave a radiocarbon date of  $8510 \pm 250$  BP (UCLA-112) (Fergusson and Libby 1962:111). Cowles states that only the lanceolate form was found between 1.5 and 2.5 feet from the bottom of the culture bearing deposit (Cowles 1959:12-14). If so, the radiocarbon date most likely refers to the stemmed points.

Agate Basin-like points were recovered from the lowest cultural level in the Mangus site (24CB221) in Big Horn Canyon (Husted 1965; 1969). With the exception of oblique flaking, they are identical to the Agate Basin type. The stratum is dated by radiocarbon at  $8690 \pm 100$  BP (SI-98) and  $8600 \pm 100$  BP (SI-101) (Long 1965:249).

Agate Basin and Agate Basin-like points have been found in Idaho, but presently no radiocarbon dates for them are available. Points from the Haskett site on the Snake River appear to be Agate Basin variants (Butler 1965:Figs. 9, 10). A specimen from Sawmill Canyon (10BT62) appears to be an Agate Basin or Agate Basin-like point (Swanson, Butler, and Bonnicksen 1964:Fig. 36cc). Two other specimens from this site, described as Hell Gap-Agate Basin varieties, do not appear to be of either type (Fig. 36h, i). Two specimens from Birch Creek described as Hell Gap points but illustrated as Agate Basin points appear to be of the latter type (Swanson and Bryan 1964:10-11, Fig. 5w, x).

Edgar located a site that produced obliquely flaked, Agate Basin-like points identical to those from the Mangus site on top of a mountain west of Cody, Wyoming. All were surface finds with no datable associations.



The base of an Agate Basin or Agate Basin-like point was recovered from Occupation III of Bottleneck Cave (48BH206) in Big Horn Canyon. The dominant type in the layer was the Pryor stemmed point (Husted 1968). The occupation has two radiocarbon dates,  $8160 \pm 180$  BP (SI-240) and  $8040 \pm 220$  BP (SI-241). Another basal fragment of an Agate Basin-like point came from Occupation I of the Sorenson site (24CB202), also in Big Horn Canyon. This zone also contained two point stems believed to be from Alberta points, and a nearly complete Scottsbluff point variant identical to specimens from Alberta, Canada (Wormington and Forbis 1965:Figs. 7a, 39b, 60a). Occupation I is dated by radiocarbon at  $7960 \pm 150$  BP (SI-308).

### **LAYERS 8–11 COMPARISONS**

The flat base projectile points from Culture Layers 8, 9, and 11 are duplicated by a single specimen from Occupation III of Bottleneck Cave. In this instance the point appears to have been reworked slightly, but the original flat base in unaltered.

A needle identical in size and form to the two from Layers 10 and 11 also came from Occupation III at Bottleneck Cave.

### **LAYER 14 COMPARISONS**

The reworked projectile point from Culture Layer 14 is of the Lovell Constricted type mentioned above concerning the point from Culture Layer 4.

A specimen from a site in Waterton Park, Alberta, north of Glacier National Park, appears to be a Lovell Constricted point (Reeves, personal communication dated February 8, 1967).

Several specimens from the lowest level of Pictograph Cave near Billings, Montana are nearly identical to specimens from Big Horn Canyon (Mulloy 1958:Fig. 6, Nos. 7, 8).

Edgar has found a number of Lovell Constricted points on surface sites and concludes that the type is restricted to the mountains. He has seen specimens from the Big Horn Mountains, Trout Peak, and Pat Ohara and Jim Mountains in the Absaroka Range.

The other chipped-stone implements from Culture Layer 14 are unimpressive and are characterized by a general crudeness. This is also true of the complex from Occupation I of Bottleneck Cave in Big Horn Canyon. The principal difference between these two occupations is the presence of grinding stones at Bottleneck Cave.

### **LAYER 16 COMPARISONS**

A striking change in projectile point form takes place in Culture Layer 16, the next higher productive occupation level. Four styles are present, but most numerous is the Blackwater Side-Notched point. The type is found in sites along the eastern Plains border and in Idaho.

An identical specimen was recovered from the Simonsen site, a bison kill in northwestern Iowa (Agogino and Frankforter 1960:Fig. 1c; Mason 1962:Fig. 3, upper right). Charcoal from a hearth in the site was radiocarbon dated at  $8430 \pm 520$  BP (I-79) (Walton, Trautman, and Friend 1961:58). A specimen from Stratum 1 of Modoc Rock Shelter, Illinois appears to be of the same type although it is somewhat longer (Fowler 1959:Fig. 7). This level has two radiocarbon dates,  $10,651 \pm 650$  BP (C-907) and  $9101 \pm 440$  BP (C-908) (Libby 1955:103).

Similar specimens were recovered from the Logan Creek site in eastern Nebraska (Kivett 1962). A proximal fragment with slightly concave base came from Zone F the lowest, and complete examples with shallowly concave bases were recovered from Zones D, C, and A. Zone D has a radiocarbon date of  $7250 \pm 300$  BP (M-1081) (Crane and Griffin 1962:195).

Apparently identical projectile points were found in Alpha and Beta shelters on the Salmon River in eastern Idaho (Swanson and Sneed 1966:Figs. 18f, g; 20a). Layer 6c at Alpha contained the greater number of side-notched points and was dated by radiocarbon at  $7150 \pm 230$  BP (WSU-359) (Swanson and Sneed 1966:12).

In Montana, Blackwater Side-Notched points were collected at the Carbella site (Arthur 1966:Figs. 20i, 21g, i). Unfortunately they occurred in a mixed surface association and cannot be dated.

Specimens similar to the corner-notched points from Layer 16 are common throughout Wyoming as well as other western states, but they date from a later period. Corner-notched projectile points have been assigned to early levels in western sites, but there are reasons for doubting that the specimens actually belong in such layers. At present, and until such time that more comparative data becomes available, little can be said concerning the Mummy Cave specimens.

### LAYERS 17–19 COMPARISONS

The Pahaska Side-Notched point was the only type found in Culture Layers 17, 18, and 19. One example came from Layer 16. The type is found at all of the sites mentioned above in connection with the Blackwater Side-Notched point. Examples were recovered from Zone B of the Logan Creek site dated at  $6633 \pm 300$  BP (M-837) (Crane and Griffin 1960:40).

The Hill site near Glenwood in western Iowa produced a complex very similar to that at the Logan Creek site. Projectile points from the site are identical to the Pahaska Side-Notched type (Frankforter 1959: Pl. 1, Nos. 1–5). The site has a radiocarbon date of  $7250 \pm 400$  BP (M-984) (Crane and Griffin 1962:195).

Projectile points considered within or to overlap the typological range of the Logan Creek points were unearthed at Site 25FT31 in the Red Willow Reservoir of southwestern Nebraska. Chipped-stone blades, random flake scrapers, some crude bone implements, and the side-notched projectile points from the Feature 5 zone were designated the Spring Creek complex (Grange 1962:7). The complex has a radiocarbon date of  $5860 \pm 160$  BP (M-1364) (Crane and Griffin 1964:10–11).

Pahaska Side-Notched points have been recovered from numerous sites in Idaho where they as well as other side-notched styles are called Bitterroot points. The aforementioned Alpha and Beta shelters contained specimens identical to those in Layer 17. These points are representative of the Bitterroot culture, the predominant pattern in the region after 5000 BC (Swanson and Sneed 1966:43).

Several sites in the Birch Creek Valley of southeastern Idaho produced Pahaska Side-Notched points. They occur below the earliest dated horizon of Veratic Cave, Level 29, dated at  $5870 \pm 120$  BP (UCLA-161) and  $5670 \pm 120$  BP (UCLA-162) (Fergusson and Libby 1963:2–3). The side-notched points are an undetermined number of years older.

Four Bitterroot Side-Notched points were found in Layer 8 of Site 10CL100 (Swanson, Butler, and Bonnichsen 1964:Table 8). The level has two radiocarbon dates,  $4500 \pm 100$  BP (UCLA-255) and  $3170 \pm 80$  BP (UCLA-256) (Fergusson and Libby 1964:332).

Layer 20 at Cottontail Rock Shelter (10CL23) produced three Bitterroot Side-Notched points (Swanson, Butler, and Bonnichsen 1964:Table 4). The stratum is dated at  $4420 \pm 145$  BP (WSU-137) (Swanson, Butler, and Bonnichsen 1964:116).

Twenty-one Bitterroot Side-Notched points were recovered from Stratum 3 of Weis Rock Shelter in western Idaho. They were assigned to the Grave Creek phase with a beginning date of 1490 BC (Butler 1961:54, Fig. 9ss).

Projectile points described as Bitterroot Side-Notched were found in Excavation Units 7–9 of the Columbet Creek Rock Shelter in Owyhee County, southwestern Idaho. Several illustrated specimens are identical to those from Culture Layers 17, 18, and 19 (Lynch and Olsen 1964:Figs. 5e, f, o–q; 6q).

Pahaska Side-Notched points have been found at a number of surface locations in Montana and Wyoming. Several specimens were collected from the Carbella site (24PA302) in Montana (Arthur 1966:Fig. 21d–h; personal communication 1967).

Edgar has found examples on Pat O'Hara Mountain east of Mummy Cave, in the northern Big Horn Mountains, on the lower Shoshone River, and in Big Sandy Coulee — all in northwestern Wyoming. He collected specimens from the Red Desert of south-central Wyoming and along the Green River in southwestern Wyoming. Edgar states that although Pahaska Side-Notched points have been found around now dry lakes and in deflation basins short distances east of the mountains, the general feeling is that they are concentrated in the high plateau, foothill, and mountain regions.

Farther to the south in Dinosaur National Monument, Pahaska Side-Notched points were recovered from Deluge Shelter. Unfortunately, nearly all of the specimens, notes, and photographs were lost in a flashflood that destroyed the excavation camp (Leach 1966).

Comparisons of artifacts other than projectile points are not as illuminating. The Simonsen site collection included crude side and end scrapers, knives, and utilized flakes (Agogino and Frankforter 1960: 414–415; Frankforter and Agogino 1959:485–486; 1960:69). Detailed descriptions of these artifacts are not available; however, the general flavor of crudity of the Simonsen specimens is characteristic of the implements from Layers 16–19.

Flake scrapers were recovered from 25FT31 (Grange 1962). Again, detailed description is lacking for the artifacts, but the Simonsen site and Spring Creek complex assemblages contrast with those from Logan Creek and the Hill site. Side-notched, plano-convex end scrapers were present at the latter two sites but not at the former. Neither have they been reported with the side-notched points at western sites.

#### **LAYER 21 COMPARISONS**

The one projectile point from Culture Layer 21 compares most closely with specimens from later components in Mummy Cave and sites on the western Plains of Wyoming and South Dakota. It is very similar to the eared, indented base points from Culture Layers 28 and 30. It differs by having a somewhat more deeply notched base, and the side notches are obliquely oriented toward the tip at a greater angle. Exact comparisons are lacking because no sites or levels within sites containing the point type are known in the region.

#### **LAYER 24 COMPARISONS**

The same is true for the material from Layer 24. Side-notched points are present, but on others there is a tendency toward basal indenting and incipient stemming. Somewhat similar specimens can be found, but they are associated with later manifestations. The major category, the stemmed, straight to concave base point, is similar to the Hanna point but differs in stem shape and length (Wheeler 1954:8).

The side-notched forms are reminiscent of the Pahaska Side-Notched point; however, in all but one case, the notches have become very shallow and the bases are straight.

#### **LAYER 25 COMPARISONS**

The large, well-made, side-notched projectile point from Layer 25 compares most closely with the Pahaska Side-Notched point yet differs in detail. The notches are wider and do not parallel the basal edge. The point is also widest above the notches rather than below. Similar specimens on a comparable time level are lacking.

## LAYER 28–30 COMPARISONS

Mixture between Culture Layers 28 and 30 is indicated by parts of broken artifacts assigned to one level fitting parts from the other stratum. The extent of this mixture cannot be determined, but I suspect that an unknown number of complete artifacts are now associated with the wrong occupation layer. I believe the damage is minimal with the projectile points. It can be demonstrated that certain types from Layer 28 do not appear at other sites in assemblages like that in Layer 30 above or earlier assemblages. Downward displacement is more difficult to contend with, but in the case of the most diagnostic forms, little or no mixing seems to have occurred.

As with the assemblage in Culture Layer 24, specific comparisons with the Layer 28 material are not possible because of the lack of a reported assemblage of similar content at a comparable time level. Similarities are closest with artifacts from Culture Layer 30 and corresponding assemblages elsewhere. Close similarities with artifacts from Danger Cave Levels DII through DV are noted, especially in regard to stone work and bone tools.

The major point type in Culture Layer 28, the laterally notched, indented base form, is more typical of Layer 30 but has attributes making it simple to distinguish between the two forms. Comparable specimens are few and far between, and the contexts in which they are found suggest that they are slightly younger than Culture Layer 28.

Two of the illustrated specimens from the McKean site are similar but appear to be more crudely fashioned (Mulloy 1954:Fig. 4, Nos. 23, 27). An example from the lower Yellowstone country is identical (Mulloy and Lewis 1943:Fig. 28, No. 30).

Eared, indented base points constitute the second most numerous category in the stratum. These are common in Culture Layer 30 and will be discussed below.

The one short McKean Lanceolate point from this level also belongs to a type diagnostic of the complex present in Culture Layer 30. I suspect that this specimen actually originated in Layer 30 but cannot prove it; however, its association with this level may be valid.

The discoidal scrapers appear to be identical to specimens from the lower level of the McKean site (Mulloy 1954:448; Fig. 5, Nos. 13, 14, and lower level). Class W75 from Danger Cave seems to duplicate the Layer 28 specimens (Jennings 1957:158, Fig. 145). Type MM44 from Zones C and D (Apex complex) of the Magic Mountain site are comparable (Irwin-Williams and Irwin 1966:99, Fig. 32 top row). Discoidal scrapers from the LoDaisKa site are similar. They are thought to belong to Complex C (Irwin and Irwin 1959:138).

If Culture Layer 28 does, in fact, consist of a single occupational level, a blending of elements is indicated by the variety of projectile points from the stratum. A majority is based on the side-notched theme, but there are a few corner-notched and stemmed specimens.

Comparisons at an equivalent time level are few in number and geographic distances are considerable. The closest comparable specimens were recovered from the Magic Mountain site west of Denver, Colorado (Irwin-Williams and Irwin 1966). Here, the oldest component (the Magic Mountain complex) contained a few projectile point styles similar or identical to some from Layer 28. This complex is dated at sometime before 3000 BC. The culture it represents is considered to have been well established in central Colorado by 3000 BC (Irwin-Williams and Irwin 1966:190). The radiocarbon date of  $5255 \pm 140$  BP for Layer 28 indicates the two manifestations to be of comparable age.

The expanding stem, convex base and the small side-notched, convex base points are similar to Magic Mountain type MM3 (Irwin-Williams and Irwin 1966:Fig. 20). Most of those from the Colorado site are larger, but a few are in the size range of the Culture Layer 28 specimens. Magic Mountain type MM4 appears to be identical to the large corner-notched, convex base style (Irwin-Williams and Irwin 1966:Fig. 21).

Type MM20 (Irwin-Williams and Irwin 1966:Fig. 26) from Magic Mountain is identical to the one side-notched, concave base specimen in Layer 28. Type MM20 was assigned to the more recent Apex complex, but the type was present in three zones — B, C, and D — and since Zone D sometimes contained artifacts of the Magic Mountain complex, type MM20 may belong to the older unit. In any event, considerable mixture in the lower zones of Magic Mountain is evident.

Farther afield there is a general resemblance between the rectangular stem points from Layer 28 and specimens from the Lochnore-Nesikep locality in southern British Columbia. Several specimens from the Lehman site (EdRk:8) are of similar size and outline but have concave bases (Sanger 1966:Plate VIII a–c, e). Zone 1 of the Lochnore Creek site produced similar specimens (Sanger 1966:Plate V b–e).

Projectile points presently are the most diagnostic artifact in the assemblage from Culture Layer 30. One type, the McKean Lanceolate point (Wheeler 1952), and two broad classes are represented. The latter are the side-notched, indented base and the stemmed, indented base point. Within these two groups it is possible to factor out several varieties, especially in the stemmed, indented base category. Nevertheless, examples of two or more types are very nearly always found together, and the three categories apparently form part of a complex. McKean Lanceolate seems to be a common denominator appearing in nearly every context where side-notched, indented base and/or stemmed, indented base points occur.

The lowest level of Signal Butte yielded several McKean Lanceolate points (Strong 1936:Plate 25, 1 O), stemmed, indented base points (Pl. 25, 1 a–d), and examples of a little known variety of side-notched, indented base point (Plate 25, 1 e). More recent work at the site reveals that Level I actually consisted of three distinct cultural strata which were labeled IA, IB, and IC from the lowest upward (Bliss 1948:109). During the later tests one McKean Lanceolate point was recovered from IC and one from IB. It was suggested that these two might originally have been in IA; however, the type probably occurred in all three strata. Layer IA was dated by radiocarbon at  $3420 \pm 300$  BP,  $3450 \pm 150$  BP (104A) (Kulp, Feely, and Tryon 1951:566),  $3400 \pm 150$  BP (L-385C), and  $4550 \pm 220$  BP (L-385B) (Olson and Broeker 1959: 21–22). Layer IC is dated at  $4170 \pm 250$  BP (L-385D) (Olson and Broeker 1959:21–22). There are some considerably younger dates for these layers, but as will be shown, they probably are too recent.

McKean Lanceolate; side-notched, indented base; and stemmed, indented base points were excavated at the Gant site north of Sturgis, South Dakota (Gant and Hurt 1965:Plate 7). The occupation was dated at  $4130 \pm 130$  BP (Hurt 1961:56).

Components A and B of the Kolterman site in the Angostura Reservoir area south of the Black Hills in South Dakota produced McKean Lanceolate and side-notched, indented base projectile points (Wheeler 1957:Fig. 35, 1995:Fig. 31). Both units contained the side-notched, indented base forms, but only the lower zone, Component B, contained the lanceolate points. Component B was dated by radiocarbon at  $4230 \pm 350$  BP (M-369) and  $3630 \pm 350$  BP (M-365) (Crane 1956:670).

Occupation IV of Bottleneck Cave (48BH206) yielded McKean Lanceolate and stemmed, indented base points identical to those from Culture Layer 30 (Husted 1969:Plate 29c–f). Charcoal from a fire pit in the cultural zone gave a radiocarbon date of  $3820 \pm 200$  BP (SI-239). Projectile points identical to the straight stem, indented base category were recovered from a stratum in the Sorenson site (24CB202) downstream from Bottleneck Cave (Husted 1969:Plate 11k). This level dated to  $4900 \pm 250$  BP (I-691).

Component C of Belle Rock Shelter (48CK4) in the Keyhole Reservoir, northeastern Wyoming, contained McKean Lanceolate points. Sample C-667, associated with Component C, yielded an average radiocarbon result of  $1646 \pm 200$  BP, or AD  $305 \pm 200$  (Libby 1952:679, 1955:124). Wheeler rejects the dating, considering them too recent for the occupation and probably contaminated by percolating surface water (1957:72, 1996:55–56, 58).

Small McKean Lanceolate points and a variety of stemmed, indented base points were recovered from Complex C of the LoDaisKa site near Morrison, Colorado (Irwin and Irwin 1959:Figs. 15 and 16). One side-notched, indented base point also was found (Fig. 16, Type A2, right). The complex was dated by radiocarbon at  $3400 \pm 200$  BP (M-1004) and  $3150 \pm 200$  BP (M-1006) (Irwin and Irwin 1961:114).

Other radiocarbon dated sites include three bison traps producing eared, indented base projectile points, many of which are identical to the Culture Layer 30 specimens. One site, the Powers-Yonkee Bison Trap (24PR5) yielded one McKean Lanceolate point as well as many eared, indented base points (Bentzen 1961:13).

The Mavrakis-Bentzen-Roberts Bison Trap (48SH311) and site 48SH312 produced practically identical assemblages (Bentzen 1962:13; Frison 1968:Fig. 3). Powers-Yonkee is dated at  $4450 \pm 125$  BP (I-410) and the Mavrakis-Bentzen-Roberts trap has a date of  $2600 \pm 200$  BP (I-644) (Trautman 1963:73–74). The latter date probably is too young. Site 48SH312 has not been dated.

Eared, indented base projectile points occurred at the Oxbow Dam site in southeastern Saskatchewan (Nero and McCorquodale 1958:Fig. 5a–e). Two samples of charcoal from a hearth in the cultural zone were dated at  $5350 \pm 250$  BP and  $5100 \pm 210$  BP (Nero and McCorquodale 1958:87). Similar projectile points were found in Levels 7 and 8 of the Long Creek site, also in extreme southeastern Saskatchewan (Wetlaufer 1960:Plate 16, numbers 1, 4, and 7; Plate 18, numbers 1, 4, 6). Two other specimens from Level 8 might be McKean Lanceolate points (Pl. 18, Nos. 5 and 8). Level 7 is dated at  $4410 \pm 150$  BP (S-50), upper Level 8 at  $4620 \pm 80$  BP (S-52) and Level 8 at  $4650 \pm 150$  BP (S-53) (McCallum 1962:75–76).

Undated sites and components illustrate the wide spatial distribution of side-notched, indented base; stemmed, indented base; and McKean Lanceolate points. McKean Lanceolate points have been found in southeast Manitoba (MacNeish 1958:Plate VI, Nos. 18–20). Elsewhere to the west in Canada the side-notched, stemmed, and lanceolate forms are found over much of the southern Alberta plains, and the side-notched, indented base point was found as far north as the Peace River area (Wormington and Forbis 1965:Figs. 11, 17, 23, 25, 33, 47, 63, 67, 68, 70, 75).

To the south in Montana, side-notched, indented base points are common, and the stemmed and lanceolate styles are present in significant quantities. Surface collections from sites 24CH101 and 24CH458 in Chouteau County and 24HL409 in Hill County, northern Montana contain numerous examples of the eared, indented base type identical to the Layer 30 specimens and lesser numbers of McKean Lanceolate and stemmed, indented base points (Paul English, personal communication). A surface collection from the vicinity of Cascade in west-central Montana contains all three forms in essentially the same proportion as in the two more northern counties (Shumate 1967). Surface finds from the lower Yellowstone country south of Glendive, Montana include McKean Lanceolate; stemmed, indented base; and eared, indented base points (Mulloy and Lewis 1943:Fig. 28, Nos. 15–30). Two McKean Lanceolate points were recovered from the lowest level of Pictograph Cave (Mulloy 1958:Fig. 6, Nos. 3, 4). The Carbella site surface collection contained McKean Lanceolate points (Arthur 1966:Fig. 18a, b) and stemmed, indented base points (Figs. 18 g–j, 19 a–m).

To the east in North Dakota, McKean Lanceolate; stemmed, indented base; and side-notched, indented base points were excavated from several sites in the Bowman-Haley Reservoir area in the southwestern corner of the state (Oscar L. Mallory, personal communication 1967).

The presence of the McKean complex in central South Dakota is indicated by two stemmed, indented base and two side-notched, indented base points recovered at the Huff site in Morton County (Wood 1967:Fig. 3 k–m, o). The principal occupation at Huff is dated between AD 1400 and AD 1600 and apparently has no relationship with the indented base points. The latter specimens attest to an earlier occupation of the vicinity.

McKean complex projectile points are found throughout Wyoming. Examples from Yellowstone National Park include specimens identical to the straight stem, indented base; eared, indented base; and McKean Lanceolate groups (Hoffman 1961: various figures). Occupation 2 of the Pine Spring site in southwestern Wyoming produced three points very similar to the straight stem, indented base points in Culture Layer 30 (Sharrock 1966:Fig. 38). The occupation has a radiocarbon date of  $3650 \pm 80$  BP (GX-356) (Krueger and Weeks 1966:151).

The lower level of the McKean site in the Keyhole Reservoir area contained McKean Lanceolate points; eared, indented base points; and a number of stemmed, indented base specimens similar to those in Culture Layer 30 (Mulloy 1954:Fig. 4). A few eared, indented base points and a side-notched point similar to the large side-notched, concave base specimen from Layer 30 were recovered from the upper level. This stratum was dated by radiocarbon at  $3287 \pm 600$  BP (C-715) (Libby 1955:125).

Surface finds from the Big Sandy Reservoir area in southwestern Wyoming included McKean Lanceolate; eared, indented base; and straight stem, indented base projectile points (Davis 1956:Plate VIII i, k, m-o).

In central Wyoming, a McKean Lanceolate and one straight stem, indented base point were recovered from Level I of Wedding of the Waters Cave (48HO301) at the southern end of the Big Horn Basin (Frison 1962:Fig. 1 a, b). Shaw Cave near Laramie Peak in southeastern Wyoming yielded eared, indented base projectile points like those in Culture Layer 30 (Jennings 1957:321, Fig. 11B p, r). Further south, eared, indented base points were collected from the surface in Rocky Mountain National Park, Colorado (Husted 1962:Plate II l, m).

Several sites in Idaho contained material similar or identical to that from Layer 30. McKean Lanceolate points and one specimen of what appears to be a straight stem, indented base point were recovered from Layers 3 and 6D of Beta Shelter (Swanson and Sneed 1966:Fig. 20, n, q). Excavation Unit 4 of the Columbet Creek Rock Shelter contained McKean Lanceolate points (Lynch and Olsen 1964:Fig. 1i-k). Sites 10OE128 and 10OE129 in southwest Idaho also produced McKean Lanceolate points (Gruhn 1964:Fig. 1 a-1).

In the Birch Creek Valley several stratified sites contained Elko Eared points identical to some of the eared, indented base points from Mummy Cave (Swanson, Butler, and Bonnicksen 1964:Fig. 37 b-e). A few McKean Lanceolate points also were recovered (Fig. 36dd, ee).

Surface surveys indicate the presence of eared, indented base and McKean Lanceolate points over most of central and southern Idaho (Swanson, Tuohy, and Bryan 1959:74, Nos. 17-19, 21, 22; 78, Nos. 78, 79; Swanson, Powers, and Bryan 1964:Fig. 4h-s).

McKean Lanceolate; stemmed, indented base; and side-notched, indented base projectile points are found over much of the Great Basin where they are generally referred to as Pinto points. Some of the specimens from the Pinto Basin site are very similar to eared, indented base specimens from Culture Layer 30 (Amsden 1935:Plate 13). This is true of some of the Stahl site specimens, and in addition to these, several McKean Lanceolate points were recovered (Harrington 1957:Fig. 39). The Pinto occupation at Stahl is estimated to be some 3,000 or 4,000 years old (Harrington 1957:72).

The early level of Stuart Rockshelter in southern Nevada produced McKean Lanceolate points (Shutler, Shutler, and Griffith 1960:Plate 7f-h). Fire hearths in the early level produced radiocarbon dates of  $4050 \pm 300$  BP and  $3870 \pm 250$ BP.

The Corn Creek Dunes site, also in southern Nevada, produced one McKean Lanceolate point (Williams and Orlins 1963:Plate 2a). A series of seven radiocarbon dates derived from hearth charcoal range from  $5200 \pm 100$  BP (UCLA 526) to  $4030 \pm 100$  BP (UCLA 535) (Ferguson and Libby 1964:324-325). The occupation is interpreted as an eastward extension of southern Californian Pinto culture (Williams and Orlins 1963:35).

The Little Lake phase at the Rose Spring site (INY-372) south of Owens Lake, California, is associated with Little Lake Series projectile points, which include Pinto Shoulderless (McKean Lanceolate); stemmed, indented base; and eared, indented base points (Lanning 1963:Plate 6c, k). Lanning estimates the Little Lake phase to date from 3000 BC to 1500 BC (1963:281).

Pinto Shoulderless (McKean Lanceolate) points were excavated from Lovelock Cave (Loud and Harrington 1929:Plate 56e; Grosscup 1960:Fig. 5, Types I and V). Grosscup concluded that these points were limited to the Transitional phase estimated to date from 1000 BC to 1 BC (1960:63). Stemmed, indented

base points (Type II) were assigned to the Early phase estimated to date from 2000 BC to 1000 BC (Grosscup 1960:62).

Type 9d projectile points from the Karlo site (Las-7), northeastern California, are identical to the McKean Lanceolate type (Riddell 1960:Plate 2B, d). The accompanying bifurcate base points (Plate 1d, Plate 2a, 3d, 4) are similar but not identical to those from Mummy Cave. Type 9d and the indented base points fall within the Karlo period estimated to have begun at about 2000 BC (Riddell 1960:87).

Projectile points identical to the McKean Lanceolate and eared, indented base groups were assigned to the Early Death Valley II stage (Hunt 1960:Figs. 22–24). Lanceolate and ovate knives (Figs. 25 and 26) from Early Death Valley II sites are comparable to Layer 30 specimens. Hunt dates this stage from the Anathermal apparently to about 1000 BC (1960: 64).

A similar sequence was determined for Death Valley National Monument (Wallace 1958). Here, Period II was associated with lanceolate; stemmed, indented base, and corner-notched projectile points. Occupations of this period are Pinto-like and include Pinto Shoulderless (McKean Lanceolate) points. Wallace dates Period II from 3000 BC to AD 0 but did not distinguish between the indented base and corner-notched points as did Hunt by placing the latter form in the Late Death Valley II stage.

Type W6 projectile points from Danger Cave are identical to the McKean Lanceolate type and can be identified as such (Jennings 1957:106, Fig. 76a). Types W10 (page 110, Fig. 81a) and W30 (page 124, Fig. 100a), while not identical, are very similar to some of the stemmed and the eared, indented base forms from Culture Layer 30. W6 and W30 occur in Levels II through V, and W10 points were recovered from Levels III through V. Level II is radiocarbon dated at  $9789 \pm 630$  BP (C-611) and  $8960 \pm 340$  BP (C-640) (Libby 1955:119). There are no dates for Level III. Level IV has a radiocarbon date of  $3819 \pm 160$  BP (C-636) (Libby 1955:120), and Level V is dated at  $4900 \pm 500$  BP (M-205) and  $3000 \pm 300$  BP (M-203) (Crane 1956:670).

Lower Level 2 and Levels 3 and 4 of Deadman Cave, Utah, yielded McKean Lanceolate points called Type IV by Smith (1952:Fig. 5, A1–8). Smith's Type 5 (Fig. 5, B1–6) is similar to the straight stem, indented base category but has rounded instead of straight or sloping shoulders. Other material from Deadman Cave can be equated with Layer 30 artifacts including L-shaped scapula awls (Fig. 17, Nos. 8 and 9) and an ulna flaker (Fig. 18, No. 3). The awls came from Levels 3 and 4. The flaker cannot be assigned to a particular stratum but was in Level 2, 3, or 4.

A survey of the right of way for a pipeline extending from the Reno, Nevada, area to the vicinity of Mountain Home, Idaho, indicated the occurrence of McKean Lanceolate points at sites along the route (Tuohy 1963: 5–36, Plate 22m–r).

## LAYER 32 COMPARISONS

Comparison of the implements from Culture Layer 32 with those from other locations is difficult because of the lack of known sites or components on a comparable time level. Similar or apparently identical projectile points are known, but they date much earlier or considerably later than those from Mummy Cave. The larger corner-notched projectile points from the upper level of the McKean site are closely similar if not identical to the series from Layer 32 (Mulloy 1954:Fig. 4, Nos. 1–8). Gouges or chisels are noted in the upper level, but they appear to have undergone greater preparation than the one from Layer 32 (Mulloy 1954:451, Fig. 5, Nos. 11–13). Although definite tool categories can be recognized at McKean, discrete types within a particular category are not apparent. The McKean site upper level has been radiocarbon dated at  $3287 \pm 600$  BP (Mulloy 1954:456). Thus it may be a contemporary of Layer 32. The similarity of projectile point forms strongly indicates a relationship. Several sites in the Boysen Reservoir area in the Shoshone Basin of Wyoming produced projectile points similar and identical to those from Layer 32. The lower level of Site 48FR34 contained large corner-notched points (Mulloy 1954a:Fig. 14, Nos. 15–17). The component has a radiocarbon date of  $3540 \pm 220$  BP (Libby 1955:124).



Sites 48FR33 dated at  $3350 \pm 250$  BP (Libby 1955:124) and 48FR5 dated at  $3506 \pm 220$  BP (Libby 1955:124) contained specimens similar to those in Layer 32 (Mulloy 1954a:Figs. 21 No. 1 and 25 Nos. 13–15).

The upper level of the McKean site and sites 48FR5 and 48FR33 contained rock-filled roasting pits. Those at the latter two sites and some at McKean were shaped like a truncate, inverted cone with flat bottoms and sloping sides. Others at the McKean site were bowl-shaped like the Layer 32 pits.

Layer O in Trench V at the Willow Beach site in Arizona contained corner-notched points and rock-filled roasting pits much like those in Layer 32 (Schroeder 1961:Fig. 13). A radiocarbon date of  $2200 \pm 250$  BP was obtained for the earliest occupation. Apparently the date was run on a composite sample of charcoal collected from Layers H and O (Schroeder 1961:61). It is thus possible that the artifacts in Layer O are substantially older than the radiocarbon date.

Elko Corner-Notched points of the Early and Middle Rose Spring phases of the Rose Spring site are similar to the Layer 32 points (Lanning 1963:251, Plate 6i). The early Rose Spring phase is estimated to date from about 1500 to 500 BC (Lanning 1963:Table 9). This would place the occupation on the time level of Layer 32.

Similar projectile points have a broad distribution including the Great Basin, southern Idaho, and the western Plains, but absolute dates are lacking. Examples come from Death Valley (Hunt 1960:Fig. 30), Deadman Cave, Utah (Smith 1952:Fig. 4), Danger Cave, Utah (Jennings 1957:Figs. 89a, 90a, 93a), Birch Creek, Idaho (Swanson, Butler, and Bonnicksen 1964:Fig. 36e–g, w–z), and many other locations in these regions.

#### LAYER 34 COMPARISONS

As with the preceding assemblage, the material from Culture Layer 34 is difficult to compare with other artifacts because of a lack of dated sites and components. Two sites in the Denver, Colorado, area offer the closest comparisons. Projectile points from Stratigraphic Level 3 of the Willowbrook site are very similar to those from Layer 34 (Leach 1966:Fig. 3j–o, q). Level 3 is dated at  $2215 \pm 75$  BP.

Types MM23 and MM26 from Zone B of the Magic Mountain site are identical to the Layer 34 specimens (Irwin-Williams and Irwin 1966:Fig. 27). Zone B is tentatively affiliated with the later pre-ceramic Southwest (Irwin-Williams and Irwin 1966:206). A date of around AD 0 would not seem unreasonable for this component.

Spring Creek Cave near Tensleep, Wyoming (Frison 1965), contained a cultural level dating some 300 years more recent than Layer 34, but wood working techniques in the two components are similar. The Spring Creek Cave assemblage included tapered and spirally rasped shaft parts (Frison 1965:Figs. 6e, 7a–f), shaft slotting discards (Fig. 7l) and wood cut with an encircling groove (Fig. 7d). Shell beads (Fig. 5s, t) and two-ply cordage were also recovered.

Identical projectile points were collected from surface locations along the Clark's Fork of the Yellowstone River (Loendorf 1967:Fig. 13a–c, f–i) and the Gallatin area (Napton 1966:Fig. 18, Numbers 2, 4 lower inset) in Montana.

Site 48PL21 in the Glendo Reservoir area, Wyoming, produced specimens of what appear to be the same type as the Layer 34 points (Mulloy 1965:Fig. 9 Nos. 5–7). A single example from 48PL24 appears to be identical (Mulloy 1965:Fig. 13 No. 9). Other forms more like those from Layer 32 were found in the same layer at 48PL24; however, the stratum has a radiocarbon age of  $1330 \pm 150$  BP (Mulloy 1965:45).

#### LAYER 36 COMPARISONS

In the Wyoming area, Rose Spring Corner-Notched points have been recovered from several sites. Level III of Wedding of the Waters Cave produced three specimens of the type or a variety of the type (Frison 1962:Fig. 1k, m). Other artifacts identical to or very similar to those from Layer 36 include flake

end scrapers (Fig. 4f), notched pebbles (Fig. 4c), antler tines (Fig. 5r), Phragmites cut with an encircling groove (Fig. 5h–k), a wooden knife handle (Fig. 5p), fire drills (Fig. 5o, n), bark knots and netting. Frison does not offer an estimate of the age of Level III; however, the relationships to Layer 36 are apparent.

A number of identical projectile points were found in occupations 2 and 3 of the Pine Spring site in southwestern Wyoming (Sharrock 1966:Figs. 40, 46f). Here they were compared with a very similar but apparently unrelated type found in the Columbia Plateau, the Columbia Valley Corner-Notched point (Caldwell and Mallory 1967:49–53, Plate 11). Mixture between levels at Pine Spring make any comparisons with other artifacts impractical.

The Rose Spring Corner-Notched point occurs in the Boysen Reservoir area. At least one example was recovered at Site 48FR33 (Mulloy 1954a:Fig. 21, No. 9). Mixture is indicated by the presence of stemmed indented base and larger corner-notched points and a radiocarbon date of  $3350 \pm 250$  BP

To the south in Colorado, Rose Spring Corner-Notched points and variants of the type occur over a wide area. Zone A of Magic Mountain contained numerous examples (Irwin-Williams and Irwin 1966:Figs. 29 and 30). Culture Complex A of the LoDaisKa site produced identical points (Irwin and Irwin 1959:Figs. 26 and 27). Six specimens were recovered from Stratigraphic Level 4 of the nearby Willowbrook site (Leach 1966:Fig. 3D–H). A large corner-notched knife identical to those from Layer 36 was in association with the above points at Willowbrook (Leach 1966:Fig. 4A).

At LoDaisKa three radiocarbon dates may pertain to Culture Complex A. Ages of  $1260 \pm 150$  BP (M-1002),  $970 \pm 150$  BP (M-1003) and  $1150 \pm 150$  BP (M-1008) could apply to either complex A or C (Irwin and Irwin 1961:114). Mixture within the site makes positive assignment impossible, and all three dates are reasonable for the component. Stratigraphic Level 4 at the Willowbrook site is dated at  $1290 \pm 100$  BP (Leach 1966:46). This date is very close to that for Layer 36.

Another site in the Denver area, Hall-Woodland Cave just west of Golden, produced several Rose Spring Corner-Notched points or variants (Nelson 1967:Fig. 3, type B left and right columns). A short, wide, corner-notched specimen, much larger than the arrowpoints, may have been a knife like those in Culture Layer 36.

Cord-marked pottery was associated with the Rose Spring Corner-Notched points at all of these sites near Denver. At LoDaisKa and Magic Mountain plain gray pottery also was associated. These components were identified as Woodland occupations, and those with the plain gray pottery were thought to represent Woodland-Fremont culture contacts (Irwin-Williams and Irwin 1966:213; Leach 1967:44). On the other hand, Hall-Woodland Cave was interpreted as indicating Woodland-Shoshonean relationships (Nelson 1967:11).

The shorter variety of Rose Spring Corner-Notched point occurs on surface sites in Rocky Mountain National Park (Husted 1962:Plate IVA-G). They are also one of the more common types in surface collections from the western slope of Colorado in the vicinity of Montrose and Delta. I viewed several large collections from the region and immediately noted the frequency of occurrence of these small, often serrated arrowpoints. Investigations on the Uncompahgre Plateau in the Montrose-Delta region produced several examples (Wormington and Lister 1956:Fig. 11 upper row, Fig. 40a upper, a–d lower, Fig. 41a–f upper).

Rose Spring Corner-Notched points may occur as far east as western Nebraska. Several small corner-notched arrowpoints from Lens D at Ash Hollow Cave appear to be identical to those from the more westerly regions (Champe 1946:Plate 12g–k). Cord-marked pottery was present in Lens D along with a few Upper Republican sherds and 31 fragments of unusual types. The Upper Republican sherds were referred to Lens C, the next higher occupation. Some of the unusual types were identified as other Woodland varieties, and four others were assigned to a postulated occupation between Lenses C and D (Champe 1946:51).

Several sites or localities in southern Idaho have produced Rose Spring Corner-Notched points. Wilson Butte Cave point types 12b, 12c, and 13 all appear to be of the type in question (Gruhn 1961:Plate

37H-M). Examples were assigned to Assemblages V and VI, with a majority associated with the latter or Dietrich phase. Assemblage VI also contained pottery, arrow parts, shaft slotting discards described by Gruhn as notched wooden points (1961:102), cut wood, cordage, knotted bark, bark pads or bundles, and a moccasin. Specific comparisons between Assemblage VI and Culture Layer 36 are not possible because the former contains at least two components. The pottery and side-notched arrowpoints probably belong to a component similar to Mummy Cave Layer 38; however, both components probably are ultimately related. The artifacts other than the points and pottery could belong to the earlier component or the more recent one. Gruhn identifies the Dietrich phase as Shoshonean (1961:143) and dates it from about AD 1300 to AD 1700–1750 (Gruhn 1961:122).

At least 15 Rose Spring Corner-Notched points or variants and an apparently related form with squared or blunt barbs were recovered from the upper three layers of the Columbet Creek Rock Shelter in southwest Idaho (Lynch and Olsen 1964:Figs. 2d–f, 5r–x, 6s, t). Lynch and Olsen identified them as Columbia Basal-Notched, or Columbia Valley Corner-Notched as defined by Caldwell and Mallory (1967). The shelter was excavated by an amateur, and mixture of components makes further comparisons impossible. Nevertheless, the presence of Rose Spring Corner-Notched variants and a related style point in the northern Great Basin is documented at the site.

I suspect that the Rose Spring Corner-Notched type is present in the Birch Creek Valley sites, but here the types are loosely defined allowing the inclusion of diverse forms within a particular category. Two specimens illustrated by Swanson, Butler, and Bonnicksen (1964:Fig. 36h, i) appear to be Rose Spring Corner-Notched points. The square-barbed form definitely is present at Birch Creek (Swanson, Butler, and Bonnicksen 1964:Fig. 36m–o).

Surface finds were made on a number of sites on Owyhee and Elmore counties in southwestern Idaho. These were called Types 23 and 23 a–c (Tuohy 1963:Plate 23t–w). Examples of the type were collected in Craters of the Moon National Monument (Sneed 1967:Fig. 4o, r, s).

Rose Spring Corner-Notched points occur over most or all of Utah. Stratigraphic relationships with other types are not clear in most multi-component sites because of apparent prehistoric mixture between levels, but their position in Utah sequences seems the same as that on the Northwestern Plains and Rocky Mountains.

Type W-37 from Danger Cave fits the description of the Rose Spring Corner-Notched point (Jennings 1957:Fig. 107). Of 35 specimens, 31 were recovered from the surface levels or Level DV. One was in Level DIV and three came from Level DIII. These four specimens must be intrusive in the two lower levels. The most recent radiocarbon date for Level DV is  $1930 \pm 240$  BP (C-635). The date most probably applies to the larger corner-notched points and not those of type W-37.

Three arrowpoints from Promontory Cave No. 1 are comparable to the Rose Spring Corner-Notched type (Steward 1937:Fig. 4a, b, k). Specimen k appears to be one of the crude flake points like those from Layer 36. The predominant point type from Cave No. 1 is the small triangular side- and base-notched style typical of Mummy Cave Layer 38. The presence of at least two components is indicated at Cave No. 1. There is a radiocarbon date of  $840 \pm 75$  BP on a moccasin from Cave No. 1 (Aikens 1966:4).

Other cave and shelter locations in the Salt Lake vicinity yielded Rose Spring Corner-Notched points or variants. Several untyped specimens from Deadman Cave appear to be typical (Smith 1952:Fig. 4, B1, 4–6).

The “puebloid” points from Black Rock 3 Cave are comparable, although some are the square barb type not included in the Rose Spring Corner-Notched category (Enger 1950:Fig. 2f, g). A number of specimens from Stansbury II fall within the range of the Rose Spring Corner-Notched type (Jameson 1958:Fig. 15B, L, Q, T, U; Fig. 16S). Several point types were present at Stansbury II indicating that the site was multi-component and occupied intermittently over a considerable span of time. The stratigraphic relationships are unclear, limiting further comparisons.

The stemmed point category at the Injun Creek site includes at least two Rose Spring Corner-Notched points (Aikens 1966:Fig. 22g, h). At least two other point types were present at the site, and radiocarbon dates of  $585 \pm 90$  BP and  $345 \pm 100$  BP (Aikens 1966:14) probably refer to an occupation represented by the small triangular, side-notched points (Aikens 1966:Fig. 22a–f). Other artifacts from Injun Creek comparable to Layer 36 specimens include triangular and ovate knives (Fig. 22m, n, t–w), a flat grinding slab (Fig. 23f), scapula saws (Fig. 26a, b) and antler flakers (Fig. 26j). Whether or not some or all of these were associated with the Rose Spring Corner-Notched points cannot be determined. The site is interpreted as a Fremont-Promontory culture occupation (Aikens 1966:14).

Rose Spring Corner-Notched points and variants are widely distributed over western Utah. They are represented by Rudy's stemmed points with parallel-sided stems (Rudy 1953:Fig. 27a–d) and stemmed points with expanding stem smaller than blade (Rudy 1953:Fig. 30c–e). Rudy considers both types to be Pueblid (1953:109–111), more recently termed Sevier Fremont (Jennings et al. 1956:104). Fremont culture sites commonly contain Rose Spring Corner-Notched points and variants of the type. The Turner-Look site in eastern Utah produced 63 specimens classed as Type C (Wormington 1955:Fig. 32). Small side-notched arrowpoints were present in great number, nearly 400 specimens, suggesting that a transition in use from corner-notched to side-notched points was taking place at the site. Taylor recovered a single specimen from Poplar Knob (1957:Fig. 34K), but said they are common in Pueblo I sites and listed numerous locations where the type occurs in Utah and elsewhere. Taylor states (1957:102):

In the surface collections from the Fremont sites, corner-notched points are more numerous than side-notched ones. The stem formed by the corner-notching is usually narrow (one-third to one-half as wide as the maximum width of the specimen) and is usually slightly wider at the distal end than where it meets the blade of the point. The stems on some points have parallel sides. A few corner-notched points have relatively broad stems, but these for the most part are broader points of less delicate workmanship. The bases of the corner-notched points are slightly convex.

Gunnerson illustrates specimens from surface collections made on Fremont sites (1957:Fig. 14a–e) and from sites not identifiable as Fremont (1957:Fig. 14q–s, v–z). All are indistinguishable from the Rose Spring Corner-Notched category.

Hunt distinguished two types of small corner-notched points in the La Sal Mountains of eastern Utah that fall within the range of the Rose Spring Corner-Notched point. Both types (Hunt 1953:Fig. 10a–q; Fig. 11a–j) are believed to represent the Fremont culture present in the area prior to about AD 1300 and probably as early as AD 500 (Hunt 1953:18). Other artifacts related to the Fremont sites that compare with Layer 36 specimens include oval knives, disc scraper planes, and core and cobble choppers (Hunt 1953:20).

In Arizona, Rose Spring Corner-Notched points or variants were excavated from the upper levels at Willow Beach. Although specimens were recovered from Levels A, B, and C, the type was concentrated in Level B (Schroeder 1961:Figs. 12 and 20, Types V, Va, Vb). Level B constitutes the Willow Beach phase dating to the period AD 900–1150, during which several components are represented (Schroeder 1961: 102, Table 24).

Projectile points identical to and very similar to the Layer 36 points were recovered from Modified Basketmaker sites in southwestern Colorado (Martin 1939:Fig. 117 two upper rows). Notched chipped axes (Fig. 116), stone beads (Fig. 119), and eyed awls or needles very much like those in Layer 36 also were excavated. Tree-ring dates place the Modified Basketmaker period at about AD 700 to AD 860 (Martin 1939:460).

Further west in the Great Basin, arrowpoints identical and very similar to the Rose Spring Corner-Notched style have been found at a number of locations. Gypsum Cave, Nevada contained several (Harrington 1933:Fig. 56a–d). Also recovered were a scapula grass cutter or saw (Fig. 12), cane and hardwood shafts (Plate 18), pieces of cut cane (Fig. 68), digging sticks (Fig. 66a, b), and grinding slabs and handstones (Fig. 12), all similar to specimens from Layer 36. Mixture within the cave deposits precludes specific comparisons.

Humboldt Cave, also in Nevada, contained a wealth of artifacts including small arrowpoints like those in Layer 36 (Heizer and Krieger 1956:Plate 14a–e). The site also produced several other implements comparable to those in Layer 36. These include a scapula grass cutter (Plate 9a), bowed sticks (Plate 12g, h), digging sticks (Plate 12a, b), arrow parts (Plate 13b, c, e, f), wooden knife handles (Plate 15e, f), netting (Plate 25f), and basketry. The cave contained evidence of at least two occupations, but many of the artifacts collected probably came from the occupation associated with the Rose Spring points.

Another Nevada site, Lovelock Cave, contained small corner-notched arrowpoints comparable to the Rose Spring Corner-Notched style (Loud and Harrington 1929:Plate 56d, k). At least three components appear to be present in Lovelock Cave, and the stratigraphic relationships of the numerous artifacts recovered are not clear. However, the general flavor of the rich Lovelock collection is apparent in the Layer 36 assemblage.

Traits of the Death Valley III period include small, light-weight, corner-notched points, triangular and oval knives, small grinding slabs and handstones, bone tools and beads, and flexed burials beneath mounds of rock (Hunt 1960:111). All of these occurred in Culture Layer 36. Traits not found in the Death Valley III period sites but present in Layer 36 include scrapers and grooved axes. Pottery is not found in Death Valley III sites and is absent in Layer 36. The Death Valley III projectile points (Hunt 1960:Figs. 40 and 41) are very much like the Rose Spring Corner-Notched type, but in Death Valley there is a tendency for the longer form to be more common.

### LAYER 37 COMPARISONS

As far as can be determined, the projectile points from Layer 37 have few analogues in the region. These crudely made, side-notched points most nearly resemble the Avonlea point of the Northwestern Plains (Kehoe and McCorquodale 1961; Davis 1966), but the crudity of manufacture and apparent age of AD 1000 to AD 1300 indicate that they are not to be placed in the Avonlea category.

Regionally, the closest counterparts come from several sites in Bighorn Canyon to the east. The upper occupation level of the Mangus site produced several small side-notched points resembling the Avonlea type, but differing slightly (Husted 1969). Kehoe (personal communication 1964) identified them as Avonlea points but of a degenerate variety. A radiocarbon date places these specimens at  $1070 \pm 70$  BP (SI-100). Two from Culture Layer 37 (Plate 60k) are very much like the Mangus examples, but in general, the Mummy Cave specimens are considerably cruder.

At least four specimens from Ghost Cave, Montana, appear to be Avonlea or Avonlea-like points like those from the Mangus site (Mulloy 1958:Fig. 29 Nos. 2–6). Other artifacts from Ghost Cave suggest that this occupation may be a component of the Avonlea complex. This involves a problem to be discussed below.

One specimen from Stratigraphic Level 4 of the Willowbrook site near Denver, Colorado, is comparable (Leach 1966:Fig. 3i).

The Blue Dome point of eastern Idaho is described as approaching the Avonlea type in outline (Swanson, Butler, and Bonnicksen 1964:69) and tend to appear earlier than Desert Side-Notched points. This stratigraphic situation is repeated in Mummy Cave where triangular, side-notched, and side- and base-notched arrowpoints occur in the overlying stratum, Layer 38. I suspect that the Blue Dome point and those in Layer 37 are the same thing, but presently available information makes this an uncertainty.

Three specimens from the Injun Creek site in Utah appear comparable (Aikens 1966:Fig. 22a, d, e). Also found at this site were several triangular projectile points much like the two from Layer 37. Injun Creek is interpreted as a Fremont-Promontory culture site (Aikens 1966:14). Fremont culture sites also yield points notched very low on the edges. Two specimens from the Last Chance site, Utah, are similar, and triangular points also occur here (Gunnerson 1957:Fig. 9r–v).

Baumhoff and Byrne (1959:Plate 1c, s–v) illustrate specimens from eastern California that are very similar to the Layer 37 side-notched points. All have concave bases and side notches placed close to the

base. The specimens in question fall within two subtypes of the Desert Side-Notched point. One belongs to the general subtype (Baumhoff and Byrne 1959:Pl. 1c), and the others are of the Redding subtype (Pl. 1s–v). The earliest appearance of the Desert Side-Notched point, and specifically the general subtype in California is given as AD 1300. The Redding subtype appeared at about AD 1700 (Baumhoff and Byrne 1959:Table 13). Either the California specimens are a different style, or the dating of the Redding subtype is too late. The similarities of the Redding subtype to some of the Layer 37 specimens are obvious, but the difference in age of some 400 to 700 years suggests we are dealing with two different styles. Actually, the Redding subtype more closely resembles the points from the Mangus site dated at  $1070 \pm 70$  BP.

### LAYER 38 COMPARISONS

Culture Layer 38 contained the small side- and base-notched arrowpoint found over a wide area of the west. Baumhoff and Byrne date the appearance of the base-notched (Sierra subtype) form at AD 1400 in Owens Valley (1959:Table 13). Apparently they appear later moving northward suggesting that the trait of base notching may have originated in the southern Great Basin, at least in the west. Kehoe (1966: Fig. 1) concluded that basal notching appeared on the northern Plains in the 17th century. That this type of point is late in the west seems to be an established fact. On the western Plains the style is always found at or near the top of stratigraphic sequences, and this apparently is true to the west.

Four side- and base-notched and three small triangular points were recovered from Level IVb of Wedding of the Waters Cave (Frison 1962:Fig. 1p–r) and two of the notched points came from Level IVa immediately below (Fig. 1o). Level IVb also contained an unidentified iron implement indicating that this component is historic in age.

Pictograph Cave IV material from Empty Gulch included side- and base-notched points (Mulloy 1958:Fig. 25, Nos. 1, 3–6). As in Layer 38, Pictograph Cave IV points also included the side-notched style without basal notches (Fig. 25, Nos. 7–10). Flat-bottomed pottery sherds identical to that from Mummy Cave also occurred in the Pictograph Cave IV material from Empty Gulch (Mulloy 1958:Fig. 25, No. 22).

Lenses 1 and 2 of Birdshhead Cave contained side- and base-notched arrowpoints (Wheeler 1957: Figs. 94b, c; 95b–d). Lens 2 also produced a triangular point (Fig. 95a). Pottery sherds considered to be the product of Shoshone manufacture were found in both lenses, but an insufficient number were recovered to determine vessel forms. Component A, in Lens 1, has a minimum date of AD 1880 and Component B, in Lens 2, has a minimum date of AD 1784, both ages determined by tree-ring counts (Wheeler 1957:144).

Gruhn (1961:146–147) apparently accepts the small side- and base-notched point as evidence of Shoshoneans, at least when found in areas dominated by the Shoshone. Gruhn recovered five specimens at Wilson Butte Cave (Gruhn 1961:Plate 14o, p). Of these, two were in Stratum A and three were found in disturbed areas. One side-notched point without the basal notch also came from Stratum A (Plate 14M, N). Assemblage VI found in Stratum A constitutes the Dietrich phase estimated to date from about AD 1300 to some time before the introduction of Euroamerican trade materials (Gruhn 1961:122). The presence of Rose Spring Corner-Notched points in Stratum A (Gruhn 1961:Plate 37H–K) indicates the presence of at least two components. The radiocarbon date of  $415 \pm 150$  BP for the middle part of Stratum A (Gruhn 1961:122) probably dates the side- and base-notched points.

Pottery from Stratum A of Wilson Butte Cave is considered to be Shoshonean (Gruhn 1961:99–100). The sherds appear to represent wide-mouthed bowls, but one sherd with a thickening on one side may be from near the base–body juncture of a flat-bottomed vessel. Gruhn associates the pottery with the latest prehistoric occupation of the site.

Flat-bottomed Shoshone pottery was found in Graeber Cave in the foothills of the Rocky Mountains near Tiny Town southwest of Denver, Colorado (Nelson and Graeber 1966:Fig. 4). Other artifacts from the cave include one Rose Spring point and a small triangular point (Nelson and Graeber 1966:Fig. 3a–b).

In the Birch Creek Valley, the small side- and base-notched arrowpoints are believed to represent occupation by the historic Northern Shoshone (Butler 1968:91). These occur in the latest or Lemhi phase of the Birch Creek sequence. Butler states that small corner-notched points are present in the early part of the Lemhi phase and glass beads occur in the later part.

Hunt's Death Valley IV occupation, dating from about AD 1000, is distinguished from the preceding Death Valley III period by the presence of small triangular side-notched points, some with basal notches, unnotched points, and pottery (Hunt 1960:163). Some of the pottery (Hunt 1960:Fig. 56) is very similar to the vessel from Layer 38, and some of the projectile points are indistinguishable from the Layer 38 specimens.

Many more comparisons could be made with the Layer 38 assemblage, but that the point types and pottery occur in late prehistoric times seems generally agreed. The Layer 38 radiocarbon date of  $340 \pm 90$  BP is in agreement with the Wilson Butte Cave date for the Dietrich phase, and the generally late appearance of side- and base-notched points on the northern Plains.

## Chapter X: Interpretations

Caldwell (1966) described pre-World War II archeology in the eastern United States as mainly descriptive, its students addressing themselves to problems of defining prehistoric cultures which were ordered in a succession of assemblages or complexes within restricted areas. A multiplicity of names for the same cultural manifestations resulted. There followed a period of integration, resulting in what Caldwell described as a new American archeology directed to the description of culture processes and the presentation of inferences derived from "... changes in cultural forms seen through time — that is, through stratigraphic and constructed sequences" (1966:337).

I agree wholeheartedly that we should go beyond the basic ordering of our sites and components into ladder-like chronologies and the integration of these into regional or areal sequences. The mere fact that such integration is possible holds forth promise of alternative interpretations. I submit that in the west, however, we are just beginning to identify and order our data, and that until we know what manifestations are present and have clearly delineated their limits in space and time, interpretations of intra and inter-cultural relationships and processes may be misleading if not altogether invalid. Basic descriptive archeology is a necessary first step in an area where, by no stretch of the imagination, is there general agreement on the identification, age, and sequential ordering of the archeological assemblages.

This problem is further compounded by a culture area or regional approach to archeological investigations. In the west, we have the Great Basin, the Columbia Plateau, the Northwestern Plains, the Rocky Mountains, and other geographic units. Despite certain similarities in the cultural material of these regions, each has, for the most part, been treated archeologically as if it were more or less unique. Inter-regional and inter-areal relationships have not been explored in detail and significantly different sequences and chronologies based on quite similar data have been offered. Examples include the Northwestern Plains sequence developed by Mulloy (1958), the archeological Desert culture based principally on the excavation of Danger Cave (Jennings 1957), the Death Valley sequences (Hunt 1960; Wallace 1958), and the sequence in the Birch Creek Valley of eastern Idaho (Swanson, Butler, and Bonnicksen 1964). Mulloy's outline illustrates a progression of projectile point types and other possible diagnostic artifacts through time. Danger Cave produced a very similar series of point types, but most are said to have appeared very early and to have persisted for several millennia. The Death Valley sequences, containing most of the Danger Cave point types, closely parallel Mulloy's outline. At Birch Creek, Rocky Mountain and Plains types appear in a sequence but are said to have persisted for thousands of years before disappearing.

Bearing in mind the premise that typological identity implies cultural relationship and chronological equivalence, comparison with the Mummy Cave artifacts were extended as far as possible. Primary consideration was given to a comparison of projectile points, and this artifact class bears much of the interpretive load. In a discussion of the apparent low value accorded stone by prehistoric peoples, Jennings (1957:279) asks "If flint were thus cheap, one wonders how important it was. How valid are detailed reconstructions of cultural history based on flint typology?"

I submit that reconstructions based on projectile point types are no less valid than those derived from the analysis of ceramics. Point styles seem to change at a slower rate than pottery styles, and the finer chronological distinctions permitted by the use of pottery are not possible with projectile points. Nevertheless, an attempt will be made to demonstrate that projectile points are useful not only in the definition of cultural units and the establishment of chronologies but also in the determination of cultural relationships, population movements, culture contact, and the like.

The evidence from Mummy Cave forms the basis for a re-evaluation of the archeological Desert culture based on the interpretation of Danger Cave (Jennings 1957) and the cultural sequence developed for the Birch Creek Valley (Swanson, Butler, and Bonnicksen 1964; Butler 1966, 1968).

Although Mummy Cave is situated in the Rocky Mountains, it is considered to have intimate archeological relationships with the Northwestern Plains, the Great Basin, and southern Idaho. The assem-



blages contained in approximately the upper one-third of the deposits can be placed in Mulloy's (1958) Early Middle, Late Middle, and Late Prehistoric periods. The middle third produced assemblages not yet discovered or recognized at the time of Mulloy's study. The lower one-third, corresponding in time to Mulloy's Early Prehistoric period, contained little-known elements considered to be related to some of those in Mulloy's early period. The Mummy Cave sequence and additional recently acquired evidence can be combined with Mulloy's outline to establish a chronological sequence of assemblages for the Northwestern Plains and central Rocky Mountains area. It is believed that nearly this entire sequence is paralleled by that of southern Idaho. The upper half, representing the last 5,000 years or so, can be related to much of the Great Basin, and provides a basis for making broad inferences derived from observed changes in the form and spatial distribution of diagnostic artifacts through time.

The interpretation of Mummy Cave results in a construct considerably different from both that of the Desert culture and the Birch Creek sequence. Both of these models imply the existence of a culture with great time depth that was characterized by the accretion and persistence of particular artifact styles. Whereas there is no implication of genetic relationship in the Desert culture concept, the Birch Creek sequence is postulated to culminate with the historic Northern Shoshone of Idaho. Culture change is more apparent in the Idaho sequence, but as in the Desert culture hypothesis, the retention of various styles of artifacts for several millennia is an outstanding feature of the hypothesized Birch Creek continuum.

In order to provide a basis for this discussion, the evidence from Mummy Cave and its implications, as interpreted here, will first be considered without specific reference to Desert culture or the Birch Creek continuum.

It is hypothesized that the Aztec-Tanoans are descended from the early Plains big game hunters represented by the Agate Basin complex; that the divergence of the Utaztekans and Kiowa-Tanoans occurred early, possibly 10,000 to 9,000 years ago, with one branch occupying the central Rocky Mountains of Idaho, Montana, and Wyoming, and the other remaining on the western Plains; that with the approach of the Altithermal about 6000 to 5500 BC, the Plains branch migrated northward and then westward into the northern Rocky Mountains of southern Alberta and British Columbia; that the central Rocky Mountain branch was displaced to the north by an intrusion of an eastern population at about 6000 to 5500 BC, that the eastern people eventually moved westward to the Columbia Plateau followed by a slow return of the displaced mountain branch to the central Rocky Mountains of northwestern Wyoming; that at the end of the Altithermal about 3000 BC, the Aztec-Tanoans spread from the northern and central Rocky Mountains to occupy the western Plains, southern Idaho, the Great Basin, and Southwest, these regions being essentially abandoned by man during the Altithermal. It is hypothesized that Shoshoneans have occupied northwestern Wyoming for the past five millennia.

The meager collection of artifacts from Culture Layers 1–7 of Mummy Cave provides little basis for conclusive statements. The initial occupation, a prismatic blade-using manifestation, probably dates around 9,500 years ago. Culture Layers 2 and 3 produced no artifacts, and all that can be said of them is that between 9,500 and about 9,300 years ago man sought shelter in Mummy Cave, apparently for very short periods of time.

The projectile point assigned to Culture Layer 4 is an anomaly. It is not what I expected at this time level ( $9230 \pm 150$  BP). Its near identity to the projectile point from Layer 14 and specimens from rock-shelters in Big Horn Canyon dated at about 8000 BP leads me to suspect its association with Layer 4.

This specimen was recovered from an area of rock fall adjacent to the rear wall of the shelter during cleanup of the excavations on the final day of work in 1966. The thin, charcoal-stained stratum making up Layer 4 had become indefinite several feet farther toward the front of the overhang, and bits of charcoal scattered throughout fine silt and rock were the only evidence of a cultural stratum. This situation obtained near the wall from Culture Layer 18 downward, and I strongly suspect that the projectile point originated in a higher occupation zone, possibly Layer 14. A large slab of stone lay on edge near the wall with Layers 3 through 16 ending against it. Immediately south lay another large block near the locus of the projectile point. Smaller pieces of rock ranging in length from two feet to a few inches were thickly

scattered throughout the area. It is possible that the projectile point originated in a higher occupation zone, possibly Layer 14. However, if the point originated in Layer 14, it must have dropped vertically about six feet.

Projectile points nearly identical to or very similar to the Layer 4 specimen from sites elsewhere date considerably later in time. The attributes of parallel-oblique flaking, constriction of lateral edges, and basal concavity are diagnostic of the Lovell Constricted point (Husted 1969). This type was found in the Sorenson site (24CB202) and Bottleneck Cave (48BH206) in Big Horn Canyon. At Sorenson the points were dated by radiocarbon at  $7800 \pm 250$  BP (I-612) and  $7560 \pm 250$  BP (I-689). The level containing the type at Bottleneck Cave has a radiocarbon date of  $8270 \pm 180$  BP (SI-237). The Layer 4 point also is similar to the Allen point dated at  $7900 \pm 400$  BP (M-304) at the type site south of Laramie, Wyoming (Mulloy 1959:113).

In Big Horn Canyon, the Lovell Constricted point is preceded in time by an Alberta-Scottsbluff-like occupation dated at  $7960 \pm 150$  BP (SI-308) and Agate Basin-like projectile points with dates of  $8690 \pm 100$  BP (SI-98) and  $8600 \pm 100$  BP (SI-101) (Husted 1969). On the Plains, complexes coeval with Culture Layer 4 contain stemmed points of the Hell Gap, Alberta or Cody types. Obliquely flaked types such as the Frederick point (Agogino, Rovner, and Irwin-Williams 1964:1352) are more recent than Layer 4. In other words, nowhere in the surrounding territory do points resembling the Layer 4 specimen occur at a time level approaching 9,300 years ago.

The available evidence leads me to conclude that the Layer 4 projectile point is out of place and probably was originally emplaced higher in the deposits, most likely in Culture Layer 14.<sup>5</sup>

The attribute of parallel-oblique flaking appears definitely for the first time in Layer 6 estimated to date at about 9000 BP. The graver made on a broken projectile point and the presence of bowl-shaped fire pits indicate a relationship with succeeding levels and with components in Big Horn Canyon, of which more will be said below. Otherwise, the lack of diagnostic artifacts prevents identification of the component.

Beginning with Culture Layer 8 adequate evidence becomes available to construct an outline of cultural developments in the central Rocky Mountains, extending from about 8,500 years ago to the 16th century. This thread of human activity can be related to developments in adjacent regions to permit a synthesis of the prehistory of a wide expanse of the western United States.

Culture Layers 8, 9, 10, and 12 produced lanceolate projectile points with narrow, concave, or straight bases. Points of this type were found at the Ray Long site (39FA65) in western South Dakota, but unfortunately, the manuscript describing the excavations has not been published (Wheeler 1957). Certain projectile points from this site were named Angostura, and Wheeler provided a type description; however, the publication of a brief report on the site including a photograph of a projectile point (Wormington 1967:138–141, Fig. 45) not conforming to Wheeler's description has resulted in confusion, and the type has become a catch-all for a variety of lanceolate, obliquely flaked projectile points from diverse areas of North America.<sup>6</sup>

Several types of points were recovered from the Ray Long site. Wheeler (1995) illustrates several narrow base, lanceolate points (Fig. 47), a Hell Gap point (Fig. 48a), and a point or preform shaped like an Agate Basin point, but without the parallel transverse flaking of the type (Fig. 48b). Irwin (1967:316–317) mentions the presence of two types and believes the Angostura description to be a composite of Agate Basin and the lanceolate points with narrow concave or straight bases. In reality, most of the latter type points were recovered from the surface, but it is perfectly clear that the description refers to them.

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<sup>5</sup> *Senior Author's Note:* The projectile point from Layer 4 is now considered to be properly associated with that stratum. It is not a Lovell Constricted point, and excavations at the Medicine Lodge Creek site on the eastern margin of the Bighorn Basin produced an identical projectile point with a similar radiocarbon age (Frison 1991:Fig. 2.33). These two specimens represent yet another foothill-mountain Paleoindian projectile point type in the Middle Rocky Mountain region.

<sup>6</sup> *Senior Author's Note:* The report of investigations in the Angostura Reservoir, South Dakota, containing the description of the Angostura point was published in 1995 (Wheeler 1995). Citations in the following text refer to the 1995 publication.

Wheeler (1995:415–416) describes the Angostura point as:

... a large, slender lanceolate point, the symmetrical sides of which incurve to the tip and taper to the narrow base forward from the base about two-fifths to one-half of the total distance from base to tip. The base is either shallowly concave or irregularly straight. Each face bears parallel diagonal ripple flake scars, i.e., long, narrow, extremely shallow flake scars, running from upper left (tip) to lower right (base) and generally extending in from each lateral edge but sometimes reaching completely across the face. A few specimens also show horizontal ripple flake scars. Ripple flake scars may occur over the entire surface except at the extreme tip and near the base, where small and minute scars occurring in a row or crescent-shaped area mark the removal of longitudinal flakes for the purpose of thinning the blade at the base. Usually, diagonal ripple flake scars of about equal length extend from each lateral edge to or just beyond the midline; the faces are smoothly convex from side to side and the points are lenticular in cross section. Occasionally, however, ripple flake scars of unequal length — shorter on one side than on the other — occur on one or both faces and produce one or two low longitudinal ridges. In the first case, one face is smoothly convex and the other is asymmetrically ridged (Figure 47d). In the other case, both faces are asymmetrically ridged and the specimen has a rhomboidal cross section (Figure 47i). The lateral edges are commonly smoothed by grinding forward from the base for a distance of one-fourth to two-fifths of the total length of the point. The thinned concave or straight basal edge is unsmoothed. As to the ranges of size, proportions, and weight of Angostura points: no complete specimens in pristine condition were recovered from the Ray Long type site, but five complete or nearly complete examples obtained at find spots in Sioux and Dawes counties, Nebraska, in the northwestern corner of the Nebraska Panhandle some 40 to 50 miles south of the Angostura Reservoir area, provide the following data: length ranges from 66 to 83 mm; maximum breadth ranges from 21 to 27.5 mm; breadth across the base ranges from 13 to 18mm; thickness ranges from 6 to 13.25 mm; proportion (length to breadth) ranges from 2.5:1 to 3.5:1; weight ranges from 13.5 to 15.5 g.

The description agrees completely with the points Wheeler illustrates (1995:Fig. 47, Plate 17), and although it may have been premature to define a type because of the insecure nature of the stratigraphic data and dating, I do not believe any good purpose will be served by the insertion of a new name in the literature as Irwin proposes, especially in view of the fact that the lanceolate narrow base points from Ray Long do not conform to the description of Irwin's Lusk point. Irwin (1967:236–237) describes the Lusk point as:

... elongate lanceolate in form; frequently, there is a constriction of the lower third. They are invariably concave based — which is one good way to separate them from Agate Basin. They are made from blanks probably made from blades or flakes because frequently they are plano-convex in cross section. As with Frederick, these blanks were thinned by heavy percussion designed to clear the artifact from one side to the other. After this, finishing flaking, usually oblique and similar in execution to that on Frederick points, was applied. However, it is rarely as neat, and on some examples it is poor and haphazard on one or both faces. Further, there is a lack of effort to make the points of careful symmetric outline. The points are usually basally ground. They are about 3 to 6 inches in length and are always of a lower width/length ratio than Frederick points.

Irwin appears to have devised a composite description including two styles one of which appears to fit Wheeler's Angostura description. Three specimens from the Greene site (Irwin 1967:Plate 45 top row, left, right, center right) appear to be Angostura points. One from the Hell Gap site (Plate 45, top row, left center) is comparable. Three others, two from Hell Gap (Plate 45 bottom row, left, center) and one from Patten Creek (Plate 45 bottom row, right) would seem to be another type. They are long, very narrow, and have constricted edges above the base. They do not fit Wheeler's description.

I feel the name Angostura should not be discarded. It is firmly entrenched in the literature, however incorrectly, and will not disappear easily. The projectile points from Layers 8–10 and 12 in Mummy Cave are identical to Wheeler's description and are firmly dated in a stratigraphic context that permits them to be related to later point types that appear to have an affinity with what I believe Irwin calls Lusk points. With Wheeler's description and the points from Mummy Cave, we can adequately define the Angostura point and remove the confusion that has surrounded the type since excavation of the Ray Long site.

Angostura points were recovered from four levels: Layers 8, 9, 10, and 12; those in Layer 11 probably were of the same type although the basalt specimen is very crudely manufactured. These levels date from  $8430 \pm 140$  BP to  $8100 \pm 130$  BP.<sup>7</sup>

Artifacts other than projectile points were few in number and include crudely formed cutting and scraping implements, cobble choppers and hammerstones, and well made bone awls and needles. Fire pits were principally of two kinds, shallow basin-shaped depressions and deeper bowl-shaped pits. A few examples of surface fires were noted. It is apparent that the same cultural manifestation is represented in all five layers.

The next artifact-bearing level, Culture Layer 14, contained one reworked Lovell Constricted point and crude cutting and scraping tools not unlike those in the preceding levels. One basin-shaped fire pit was recorded.

For several reasons, I am convinced that Layers 8 through 12 represent a mountain-adapted culture derived from the Plains big game hunters and specifically the Agate Basin complex. Possibly Layers 1–7, or some of these, represent earlier phases of this montane culture. I believe that Layer 14 and the early Bighorn Canyon assemblages are involved, but whether this involvement is direct or indirect cannot be ascertained at present.

All of these assemblages contain projectile points with parallel-oblique flaking. The earliest occupation of the Mangus site (24CB221) in Bighorn Canyon contained a few points identical in all but one respect to the Agate Basin point — they differed in having parallel-oblique flaking. This occupation is dated at  $8690 \pm 100$  BP and  $8600 \pm 100$  BP. The level contained more than ten basin- and bowl-shaped fire pits.<sup>8</sup>

Another digression is necessary at this point. Concerning the early Mangus occupation, Irwin stated (1967:64):

The third level contained materials identified by Husted as Agate Basin but certainly belonging to the Lusk Complex. We have here a recapitulation of the old confusion between Agate Basin and Lusk (Angostura, etc.).

Admittedly, the article on the early Bighorn Canyon material gave the impression that I had identified some of the Mangus specimens as Agate Basin points (Husted 1965:11,12). This was not intended, but the damage has been done; however, Irwin maintains the Agate Basin-Angostura confusion by assigning the early Mangus points to the Lusk complex. Only one specimen could conceivably fit the description of the Lusk point, but in view of its association with others not of the Lusk type, I consider it a variant of what I will call, for the lack of a better term, Agate Basin-like points. This specimen is somewhat asymmetric and has a straight base (Husted 1965:Fig. 1f).<sup>9</sup>

Two other points of the Agate Basin-like category have definite convex bases (Husted 1965:Fig. 1b, e). Of two other points, one has a straight stem with straight base (Husted 1965:Fig. 1a), and another is a medial section with transverse flaking and median ridges on both faces (Husted 1965:Fig. 1d). The latter two specimens are obviously not in the Agate Basin-like or Lusk groups. At present there is no reason to doubt the validity of the two radiocarbon dates for this assemblage; however, Irwin considers them to be too early (1967:113).

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<sup>7</sup> *Senior Author's Note:* Subsequently, I dated the levels from  $8740 \pm 140$  to  $8100 \pm 130$  BP. Although the dates for Culture Layers 8 and 10 are reversed, I suspected that confusion of closely spaced levels resulted in the reversal and that the date of  $8740 \pm 140$  was a valid date for the projectile points. Susan Hughes obtained the three new dates in order to resolve the situation. The three dates are in stratigraphic agreement with the original series of dates and provide a more secure dating for Culture Layers 8 through 12. The  $8740 \pm 140$  date for Culture Layer 10 is too old for that stratum and may relate to Culture Layer 7, 6, or 5.

<sup>8</sup> *Senior Author's Note:* The Mangus site specimens definitely are not of the Agate Basin type for several reasons, including morphology and age. Although called Agate Basin-like, the connotation is most unfortunate and misleading. The points most closely resemble Angostura points but differ in having convex bases. They represent yet another Middle Rocky Mountain late Paleoindian projectile point type.

<sup>9</sup> *Senior Author's Note:* This specimen is identical to those from Culture Layers 8 through 12 and is an Angostura point.

To return to the discussion of the origin of the mountain-adapted culture, I suggest that the close similarity of some of the early Mangus site projectile points to the Agate Basin type indicates a cultural relationship. The base of an Agate Basin point was recovered from Culture Layer 9 of Mummy Cave (Plate 8i).<sup>10</sup>

The proximal portion of an Agate Basin or an Agate Basin-like point was found in Occupation III of Bottleneck Cave (Husted 1969:Fig. 24). All of these levels contained basin and bowl-shaped fire pits identical to those in Culture Layers 6 through 12 of Mummy Cave.

These distinctive fire pits and the attribute of parallel-oblique flaking are believed to denote cultural relationships between the Mummy Cave and Bighorn Canyon complexes and therefore to the Agate Basin complex via Occupation I of the Mangus site. The initial occupation of the Sorenson site was an Alberta-Scottsbluff component dated at  $7960 \pm 150$  BP. This zone contained two bowl-shaped fire pits. The cultural sequence at the Hell Gap site indicates that the Cody complex is ultimately related to Agate Basin via the Alberta and Hell Gap components (Irwin 1967). The Scottsbluff point from Sorenson is like several examples from Alberta, Canada (Wormington and Forbis 1965:Figs. 7a, 26d, 39b, 60a) and is not a classic Scottsbluff point. For reasons to be presented below, I believe that these “degenerate” Scottsbluff points are younger than classic Cody complex projectile points.<sup>11</sup>

In Culture Layer 16, a completely different type of projectile point appears. This change in technology suggests the arrival of peoples from the Prairie-Plains border region of eastern Nebraska, western Iowa and further east. The Blackwater and Pahaska Side-Notched points are identical to those from the Hill, Logan Creek, Simonsen and other sites. Also present in Layer 16 are two large corner-notched points, one with an indented base. These possibly have ties with developments in southern British Columbia to be discussed shortly.

Culture Layer 16 is dated by radiocarbon at  $7630 \pm 170$  BP. The major point type in this stratum is the Blackwater Side-Notched point. Only one Pahaska Side-Notched point was present implying that the arrivals from the east came in at least two groups because the succeeding layer contained only Pahaska Side-Notched types indicating a change in form had taken place. Layers 17 and 18 have radiocarbon ages of  $6780 \pm 130$  BP and  $7140 \pm 170$  BP, respectively; however, I feel that the ages based on rate of deposition are more nearly correct, especially in view of the reversal of the radiocarbon dates in relation to the stratigraphy (above).

A new form of fire pit appeared with the introduction of the side-notched point. In addition to basin-shaped depressions were the large shallow fire pits containing, from bottom to top, a stratified fill of charcoal, burned earth and dense white ash. This type of fire pit occurred in Layers 16–18.

Parallel developments in Bighorn Canyon had some effect in the Mummy Cave region. Occupation II of the Sorenson site and Occupation I of Bottleneck Cave contained Lovell Constricted points (Husted 1969), the same type of projectile point found in Culture Layer 14. In the canyon, there were two succeeding complexes, while at Mummy Cave, the early side-notched points appeared.

The final occupation in Bighorn Canyon before an extended period of abandonment dates sometime between 6000 BC and 5500 BC. Components of this occupation contain Pryor Stemmed points, a large stemmed point with alternately beveled and serrated edges. The base is straight to indented (Husted 1969:14, 51–52).

Between the Lovell Constricted point and Pryor Stemmed point components at Bottleneck Cave was an occupation containing a small triangular point with slight shoulders and an expanding stem with a

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<sup>10</sup> *Senior Author's Note:* The resemblance is superficial. The Culture Layer 9 specimen is an Angostura point.

<sup>11</sup> *Senior Author's Note:* The foregoing argument is illogical. Occupation I of the Mangus site is not an Agate Basin complex component. However, I do believe — but cannot document — that the Middle Rocky Mountain mountain-adapted or foothill-mountain Paleoindian is ultimately related to the Agate Basin complex, most likely via the Hell Gap–Haskett complex or phase.

shallowly concave base. It was also alternately beveled and had serrated edges. All three of these components produced grinding stones indicative of hunting and the gathering and preparation of vegetal foods.

These Bighorn Canyon complexes suggest a transition toward hunting and gathering as the environment became increasingly drier with the approach of the Altithermal. Edgar states that Lovell Constricted points are found in the Absaroka Range but not the Pryor Stemmed type. It appears that the peoples represented by these complexes may have begun a westward retreat from the Bighorn Canyon region but were shunted in another direction, probably northward, by the ingress of peoples making the early side-notched points. As far as can be determined, Lovell Constricted and Pryor Stemmed points do not appear in Idaho or the area between there and Mummy Cave. Neither have they been found to the south. But the early side-notched points are found in the area and at least as far north as the Carbella site and southward to Dinosaur National Monument.<sup>12</sup>

Whether or not the Lovell Constricted point is directly descended from the Angostura point, as is suggested at Mummy Cave, is not known. If not, at least they appear to be related. In any event, the arrival of the side-notched-point-using people caused abandonment of the northwestern Wyoming region by the resident population, and it is concluded that the latter people moved to the north into western Montana and, possibly, into the southern Canadian Rocky Mountains. More will be said below concerning this movement.

There can be no doubt that early side-notched points are derived from the Simonsen-Logan Creek-Hill Site manifestation. This point form can be traced further eastward, but it is not necessary to do so. It is obvious that an eastern-derived culture is involved. The motive for a westward migration across a drying Plains environment is undetermined, but it is suggested that the people had moved westward to take advantage of bison in the Prairie-Plains border region. As the Altithermal approached and forage was reduced, the bison probably moved westward and northward toward the mountains and were followed by these eastern peoples. Conditions must have deteriorated to a point where the people found it necessary to move into the mountains to find food. They might have followed the bison northward, but it is suggested that the resident Plains population represented by the Cody complex or later derivatives were moving north toward Canada with the bison thus preventing the eastern intruders from taking advantage of this food source.

The population utilizing the early side-notched points remained in the Absaroka Range region for at least 700 to 800 years. One Pahaska Side-Notched point was recovered from Layer 19 estimated to date at about 4900 BC, but the type is gone by about 4500 or 4400 BC, the estimated age of Culture Layer 21.

The projectile point from Layer 21 is a side-notched form but has a deeply indented base. Although this style of point appears to be derived from the early side-notched form, I believe that it represents a borrowing of the side-notched style from the eastern peoples by the resident population. In Culture Layer 30 the side-notched, indented base point occurs in a complex with stemmed, indented base and McKean Lanceolate points. This situation is repeated at many so-called McKean sites on the Plains. The side-notched, indented base point is also found in the Cochise culture (Sayles and Antevs 1941) and at other sites in the Great Basin. Specific varieties differ from region to region, but the basic form is repeated.

From Layer 24 came a few stemmed points and a few side-notched specimens, one with an indented base. The former are reminiscent of specimens from south-central British Columbia, but the latter are more like the side-notched points in Layers 16–19. It is suggested that Layer 24 represents an expansion back into the Mummy Cave region by the displaced resident population after the eastern group had moved on to the west.

Farther to the west in Idaho, Oregon, and Washington, the early side-notched point continued in use after it had disappeared from the Mummy Cave region. Butler (1961) has described the Cold Springs ho-

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<sup>12</sup> *Senior Author's Note:* Edgar subsequently found a Pryor Stemmed point in the eastern Absaroka Range foothills west of Meteetsee, Wyoming. I viewed this point at Edgar's home in Cody, Wyoming, about 1995. Nevertheless, Pryor Stemmed points appear to be rare west of the Bighorn and Pryor Mountains.

rizon associated with early side-notched points. Apparently the type occurs consistently in deposits immediately overlying a layer of Mazama ash or strata of comparable age. The date of the Mazama eruption has been determined by radiocarbon analysis to have occurred at about 6600 BP (Fryxell 1965:1288). Thus, the side-notched points do not date older than 6600 BP in western Idaho, northeastern Oregon, and Washington. These points have been excavated from a number of sites in the Plateau. Most appear slightly different from the older variety in Mummy Cave being somewhat cruder and having larger notches. Others seem to be identical (Butler 1962:Fig. 9ss; Daugherty, Purdy, and Fryxell 1967:Fig. 10e; Grater 1966:Fig. 1a, b; Nelson 1966:Fig. 9; Shiner 1961:Plate 35b, Pl. 46b; Sprague and Combs 1966:Fig. 7b–d, u, v, x).

Culture Layer 28 presents a problem because of mixture with Layer 30. The extent of the mixture cannot be determined beyond the fitting together of broken artifacts, the parts of which are recorded in the notes as having been recovered from both cultural strata; however, it is possible to isolate a certain projectile form to Layer 28. One of the major styles in this level, the laterally notched, indented base point, has not been found in a datable context outside of Mummy Cave as far as can be determined. It does not appear in McKean complex sites on the Plains or in sites of the Great Basin McKean counterpart, the Pinto complex. It appears that this point style is restricted to the Rocky Mountains during the period between 3500 and 3000 BC.

The laterally notched, indented base point is a further modification of the side-notched point culminating in the eared, indented base point of the McKean complex. At least 15 examples of the eared variety were recovered from Layer 28, but I do not think that all of them originally came from Layer 30. In other words, the eared, indented base had evolved by about 3300 BC.

The rectangular stem point from Layer 28 harks back to the stemmed, straight or concave base style in Layer 24. The possible significance of these will be discussed shortly. At present it is not possible to say very much about the small side-notched and large corner-notched points. The only other similar excavated component that I am aware of is the earliest component of the Magic Mountain site (Irwin-Williams and Irwin 1966). The Magic Mountain complex contained several projectile points identical to or very similar to specimens from Layer 28. The major point type in the Magic Mountain complex, type MM3, is a rather crudely made side-notched point with convex base (Irwin-Williams and Irwin 1966:Fig. 20). The small side-notched, convex base and the expanding stem, convex base styles from Layer 28 are reminiscent of type MM3 although generally smaller. The large corner-notched, convex base style of Layer 28 is identical to some type MM4 specimens of the Magic Mountain complex (Irwin-Williams and Irwin 1966:Fig. 21).

The succeeding Apex complex at Magic Mountain contains point styles identical to some assigned to Layer 28; however, it must be kept in mind that some specimens related to Layer 28 may actually have come from Layer 30. Overlap and consequent mixture is also present between the Magic Mountain and Apex complexes. Type MM20 (Irwin-Williams and Irwin 1966:Fig. 26) seems identical to the side-notched, concave base point from Layer 28. Types MM18 and MM19 (Irwin-Williams and Irwin 1966:Fig. 25) are also very similar to the small side-notched, convex base style.

The Magic Mountain complex is believed to be local in character and to date prior to 5,000 years ago. Tenuous linkages along the Rocky Mountains toward the Pacific Northwest are suggested (Irwin-Williams and Irwin 1966:219). I believe that there exists a relationship between the Magic Mountain complex and Layer 28, but any relationship to the Pacific Northwest is considered to be extremely tenuous. That Layer 28 is ancestral to Layer 30 at Mummy Cave seems beyond doubt, and therefore, Layer 28 represents a phase of the mountain-adapted culture immediately preceding its expansion from the Rocky Mountains at about 5000 BP. The Magic Mountain complex would, therefore, also be representative of this mountain-adapted culture. The radiocarbon date of  $5255 \pm 140$  BP for Layer 28 suggests it may be coeval with the Magic Mountain complex.

It has been mentioned that the stemmed, indented base and McKean Lanceolate points appear in the McKean complex essentially for the first time. The one short McKean Lanceolate point in Layer 28 may

have actually been in Layer 30; however, there are no antecedents for these forms in Mummy Cave with the exception of the crude, stemmed points in Layer 24 and the lanceolate points in Layers 8–14. The progenitors of the stemmed and lanceolate, indented base points must lie elsewhere.

Excavations along the Fraser River between Lillooet and Lytton in south-central British Columbia (Sanger 1963, 1966, 1967) produced several kinds of projectile points that appear to be good candidates for the progenitors of the stemmed, indented base point. In the exposition of the Western Macrotradition, Husted and Mallory (Husted 1968, 1995) concluded that when Altithermal conditions became too severe, the western Plains were abandoned by the early bison hunters. It was suggested that a general northward movement toward Canada began during Cody complex times and continued, probably for a period of 600 to 800 years, until about 6000 BC. Cody complex material appears in quantity in Alberta (Wormington and Forbis 1965). Here, many projectile points identified as Scottsbluff differ significantly from the classic type but retain the basic form. It was suggested that these represent a later variety of the Scottsbluff point. One of the points from the lowest level of the Sorenson site dated at  $7960 \pm 150$  BP (Husted 1969:Fig. 7) is an example.

The evidence seems to indicate that eventually even the Canadian Plains were abandoned as has been suggested by Wormington and Forbis. However, they suggest the movement was to the north and east (1965:189–190). Husted (1968, 1995) and Mallory (1968) hypothesized that retreat was westward into the Rocky Mountains of southern Alberta and British Columbia and that the late Cody complex projectile points were ancestral to the stemmed, indented base point.

Sanger (1967:Fig. 5) illustrates a projectile point sequence for the Lochnore-Nesikep locality. Points of the Early period, 5500 to 3000 BC, include a large corner-notched form, a large point with expanding stem suggestive of the Scottsbluff type, and several varieties of elongate triangular points. The stemmed point (Sanger 1967:Fig. 5gg) is very similar to several Scottsbluff points or variants from Alberta (Wormington and Forbis 1965:Figs. 7b, 14b, 26b, 38b, 62b, 63a, 75a). The triangular points (Sanger 1967:Fig. 5hh–jj) are nearly identical to some Alberta specimens (Wormington and Forbis 1965:Figs. 8a, 31c, 35a). Apparently, the large corner-notched point does not occur on the northern Plains at this time level, but in general outline, it is reminiscent of the Scottsbluff point and the large triangular forms.

The middle period in the Lochnore-Nesikep locality, 3000 BC to 1 AD, is associated with short and long points with expanding stems and straight to shallowly concave bases (Sanger 1967:Fig. 5r–x). Some of these are serrated. The stemmed points are very much like numerous Alberta specimens (Wormington and Forbis 1965:Figs. 7b, 8d–f, 15b, d, 21a, 26b, 39a–b, 62b, 63a, 64a, 66b, 69d–e, 75a–b). The principal difference is that a majority of the Alberta specimens have straight bases.

The general impression is that the Lochnore-Nesikep projectile points are related to the Scottsbluff and Scottsbluff-like points from the Plains of Alberta east of the Rocky Mountains. Differences are apparent, but similarities are too close to be ignored. The differences would be explained best by considering the British Columbia specimens as descendants of the earlier Alberta forms and the dating of the former is in agreement with this interpretation.

The Lochnore-Nesikep sequence does not show close comparison with the Plateau area until the Late period, and the presence of microblades are believed to indicate affiliations with northern British Columbia and southwestern Yukon (Sanger 1967:191); however, these implements are found on the Alberta Plains, possibly in association with the Cody complex (Wormington and Forbis 1965:Figs. 10f, 13e–f). Relationships with the Plains are seen from McKean complex times and later (Sanger 1967:192). It is concluded that the initial occupation of south-central British Columbia was by peoples coming from the south, and that from about 5500 BC, contacts with the western Canadian plains were maintained (Sanger 1967:195).

Sanger's conclusions agree well with Husted and Mallory's hypothesis that people of the Cody complex migrated northward into Canada, and by about 6000 BC, had moved westward into the Canadian Rocky Mountains. It would be entirely logical that some of these peoples would have moved into the Plateau country between the Coast Range and the Rocky Mountains. The similarity of the Lochnore-



Nesikep projectile points to those from east of the Rockies and the lack of corresponding types in the southern plateau and to the north argue convincingly for relationships with the late Cody complex.

The general diminution in size of the British Columbia points may be explained by a change from the hunting of bison to the hunting of smaller game like the deer inhabiting the interior Plateau (Sanger 1967:186). Adaptation to a new environment would necessitate changes in the material culture inventory.

The dates ascribed to the Lochnore-Nesikep points are in general disagreement with the hypothesis of a Cody complex- McKean complex derivation. If the British Columbia material does in fact represent transitional stages, it should date between about 6000 BC and 3000 BC. The stemmed points with straight or shallowly concave bases from Zone 1 of the Lochnore Creek site and the Lehman site were assigned to the Middle Period dated from 3000 BC to AD 1; however, a radiocarbon date of  $6650 \pm 110$  BP (I-2367) was obtained for the lower component of the Lehman site (Sanger 1967:191).

The Lehman site points include some long examples with expanding stems and straight bases (Sanger 1966: Pl. VIII f-h) that are very similar to the large stemmed example (Sanger 1963:Plate VI w) from Zone VII of Nesikep Creek dated at  $5635 \pm 190$  BP (GXO408) (Sanger 1967:188). The Lehman site specimens closely resemble the Scottsbluff point, and the date of 4700 BC is in general agreement with the interpretation that these stemmed points are derived from the Cody complex points. The Nesikep Creek date therefore seems too recent, and Sanger (1967:188) reports that this date may well be falsely recent and that the component may date earlier than 4000 BC.

The large corner-notched points from Zones VII and IV of Nesikep Creek are very similar to the large stemmed points and should fall within the Early Period although Sanger assigns Zone IV to the Middle Period (1963:Plate IV L, M). The large corner-notched points, one with indented base, from Mummy Cave's Layer 16 is dated at  $7630 \pm 170$  BP, some 900 years earlier than the Lehman site but again, the similarities between the Nesikep Creek and Mummy Cave points are obvious, and a relationship may well exist. If so, Layer 16 with its side-notched points indicates the presence of two traditions. Interestingly enough, a large side-notched point was found in Zone IV of the Nesikep Creek site (Sanger 1963:Plate IV K).

The shorter points with expanding stems and concave bases from the Lehman site (Sanger 1966:Plate VIII a-c, e) and Zone 1 of the Lochnore Creek site (Sanger 1966:Plate Vd, e) should be younger than the larger stemmed forms but not as early as the radiocarbon dates from the latter site indicate. A point identical to the cited specimens was found in Mummy Cave but is not illustrated. Unfortunately, its precise provenience is not known, but the circumstances of its recovery place it in Layers 24-28. It therefore dates between about 3900 BC and 3300 BC. A point from Layer 28 (Plate 18 t) is comparable but has a straight base. Others from Layer 28 (Plate 19 a-c) are similar to some from Zone 1 of Lochnore Creek (Sanger 1966:Plate V b, c, f) and a relationship is suggested. I feel that the Lehman site and Lochnore Creek site specimens do date earlier than 3000 BC and the similarities to the points from Layer 28 strongly suggest a similar age or about 3300 BC.

The Lochnore-Nesikep Creek local sequence seems the best candidate for a transitional phase between the Cody complex and the McKean complex. The succession from Scottsbluff-like points to shorter points with a tendency toward basal indenting is apparent. Zone 1 of the Lochnore Creek site contained a stemmed, indented base point (Sanger 1966:Plate Va), which is the culmination of the sequence hypothesized by Husted and Mallory (Husted 1968, 1995).

The McKean Lanceolate point, also a part of the McKean complex, might be accounted for in the Lochnore-Nesikep Creek sequence. The lanceolate points with narrow concave bases from Zone 1 of the Lochnore Creek site (Sanger 1966:Plate V1-h) are very much like those from Layers 8-12 of Mummy Cave (Plate 8) and the Pine Spring site in southwestern Wyoming (Sharrock 1966:Fig. 35a-d). It has been proposed that the resident population in the Mummy Cave region was displaced northward by the arrival of the population making Blackwater and Pahaska Side-Notched points. The narrow concave base points at Lochnore Creek suggest that at least some of the southern population reached as far north as southern British Columbia. The presence of stemmed, indented base points in the Zone 1 assemblage at

Lochnore Creek suggests that the accompanying lanceolate indented base points may be ancestral to the McKean Lanceolate point.

More investigation in southern British Columbia is needed to affirm or contradict the above interpretations. Assuming that the Lochnore-Nesikep Creek sequence is in fact intermediate to the Cody and McKean complexes, it probably does not represent all of the transitional phases. If so, the higher valleys of the Rocky Mountains immediately to the east may be the key area, but until such time that information on this area becomes available, we can only speculate on the basis of what data are at hand.

Sanger's material is the only available data suggesting the fate of the Cody complex. The resemblance between the Lochnore-Nesikep Creek projectile points and Cody complex points seem to me too close to ignore. Sanger's dating of the various assemblages is considered too late, but if these dates are valid, my interpretations are invalid; however, there does appear to be mixture within the various stratified sites and the post-3000 BC radiocarbon dates may apply to later components. I would place Nesikep Creek Zone IV, Lochnore Creek Zones I and II, and the Lehman site in the Early Period sometime between 3000 and 4000 BC.

Sanger (personal communication March 19, 1968) related that similarities exist between the Lochnore-Nesikep material and collections from high up on the North Thompson River and in the vicinity of Prince George, British Columbia. Scottsbluff points have also been recovered from the latter area. Although he considers the mechanisms to be questionable, Sanger tends to agree with Husted and Mallory's hypothesis of a northern Cody-McKean complex transition and says the whole Lochnore-Nesikep complex may have been derived from the central British Columbia area. I still suspect that the higher country to the east of the northern Plateau will prove to be the heartland from which most of the evidence of the transitional phases will be recovered, but Sanger's material strongly suggests a substantial spread westward to the Plateau if this area is not the point of focus.

Returning to the Mummy Cave region, it will be recalled that side-notched points were recovered from Layers 21, 24, and 28 and that they differed significantly from the earlier Pahaska Side-Notched point which, along with later derivations, appears in the Cold Springs horizon in the lower Snake River-mid Columbia River region after 4600 BC. It is suggested that Layers 21-28 represent an expansion or return to the Mummy Cave region of the old resident population after the eastern peoples had moved on westward to the central Columbia Plateau.

The thinness and non-productivity of Layers 19-23, dating from about 6,900 to 6,000 years ago, suggests a sparse population in northwestern Wyoming during this 900-year span. If true, there was a lag between departure of the eastern people and return to the region of the displaced mountain-adapted population.

Earlier I stated a belief that at least Layers 8-12 represented a mountain-adapted culture ultimately derived from the Agate Basin complex by an as yet undefined sequence of intermediaries. The western Plains descendants of the Agate Basin complex, namely the Cody complex, retreated northward with the approach of the Altithermal, and by at least about 5600 BC, an eastern people displaced the resident mountain-adapted peoples northward into the mountains of western Montana and probably adjacent Alberta and British Columbia. Thus, between 6000 and 5000 BC there were the late or post-Cody complex peoples in the Rocky Mountains of southern Alberta and British Columbia, the mountain-adapted population probably immediately to the south, and the eastern group just south of them in the Absaroka Mountains and vicinity.

In order to account for the appearance of the side-notched, indented base point in the McKean complex, the simplest explanation seems to be that the displaced mountain-adapted population borrowed the side-notched point style but adapted it to their needs. The attribute of basal indenting was being developed in the post-Cody complex sequence in Canada and contact between the northern group and the mountain-adapted population would explain the appearance of basal indenting in both groups. Contact between all three groups in the mountains probably was maintained at the peripheries.

After the eastern arrivals moved on, by about 4500 BC, it appears that a slow expansion back into the Absaroka Mountain region by the mountain-adapted population began. The stemmed points in Layer 24 suggest that some of the northern post-Cody complex peoples might have come southward. Whatever the circumstances, Layer 28 contained a preponderance of side-notched, indented base points suggesting that fusion of the mountain-adapted and northern groups had not been completed.

At about 3000 BC, the McKean complex appeared over a wide area in an apparently short period of time. Table 11 lists 17 of the more than 30 radiocarbon dates for so-called McKean sites on the Plains. I have included the Oxbow Dam and Long Creek sites in Saskatchewan because the levels of interest here produced side-notched, indented base projectile points demonstrated at Mummy Cave to be part of the McKean complex. The oldest date is  $5350 \pm 250$  BP. It will be noticed that the oldest dates come from sites in Canada and Montana. This may reflect earlier reoccupation of the northern Plains since this area probably would have become habitable slightly earlier because of higher latitude; however, a radiocarbon date of  $5200 \pm 100$  BP from the Corn Creek Dunes site in Nevada (Williams and Orlins 1963:32), a Pinto site, suggests the McKean complex may have begun to spread between 3500 BC and 3000 BC. The radiocarbon dates for other McKean complex sites extend to  $2600 \pm 200$  BP for the Mavrakis-Bentzen-Roberts Bison Trap, 48SH311 (Bentzen 1962:14). This date is too recent because the site contains projectile points identical to those from a similar site, the Powers-Yonkee Bison Trap (24PR5) dated at  $4450 \pm 125$  BP (Bentzen 1961). I suspect that dates for the McKean complex younger than 1500 BC are too recent. It appears that by this time large corner-notched points had replaced the indented base styles or at least the transition had begun. In any event, the McKean complex is firmly dated to the period after 3000 BC, or at the earliest, only slightly before.<sup>13</sup>

Table 11. Radiocarbon dates for some Plains sites and components yielding indented base projectile points.

Site	Age BP	Date BC
Oxbow Dam, Saskatchewan	$5350 \pm 250$	$3400 \pm 250$
Oxbow Dam, Saskatchewan	$5100 \pm 210$	$3150 \pm 210$
Long Creek, Saskatchewan	$4993 \pm 125$	$3043 \pm 125$
Rigler Bluffs, Montana	$4900 \pm 300$	$2950 \pm 300$
Sorenson, Montana	$4900 \pm 250$	$2950 \pm 250$
Long Creek, Saskatchewan	$4643 \pm 150$	$2693 \pm 150$
Long Creek, Saskatchewan	$4613 \pm 150$	$2663 \pm 150$
Long Creek, Saskatchewan	$4603 \pm 80$	$2650 \pm 80$
Signal Butte, Nebraska	$4550 \pm 220$	$2600 \pm 220$
Powers-Yonkee, Montana	$4450 \pm 125$	$2500 \pm 125$
Kolterman, South Dakota	$4230 \pm 350$	$2280 \pm 350$
Signal Butte, Nebraska	$4170 \pm 250$	$2220 \pm 250$
Gant, South Dakota	$4130 \pm 130$	$2180 \pm 130$
Bottleneck Cave, Wyoming	$3820 \pm 200$	$1870 \pm 200$
Kolterman, South Dakota	$3630 \pm 350$	$1680 \pm 350$
Signal Butte, Nebraska	$3450 \pm 150$	$1500 \pm 150$
Signal Butte, Nebraska	$3420 \pm 300$	$1470 \pm 300$

<sup>13</sup> *Senior Author's Note:* Recent investigations at the Powers-Yonkee Bison Trap have demonstrated that the radiocarbon date of  $4450 \pm 125$  BP from 24PR5 is too old and that the Yonkee manifestation dates around 3,000 radiocarbon years before the present (Frison 1991:192) or slightly later.

The McKean complex is representative of a dramatic period in western prehistory. It forms the basis for later cultural developments over a broad area of the west. Considering the McKean complex as a cultural and temporal datum point, the direction of this study will be reversed, and the cultural sequence represented by Culture Layers 38 through 32 will be discussed beginning with the most recent occupation level. The intent is to trace a Shoshonean continuum in northwestern Wyoming back through time to the McKean complex. The story is not complete. Each occupation level in Mummy Cave was separated from the preceding and succeeding cultural strata by sterile layers. Assemblages believed to represent phases of prehistoric Shoshone culture found elsewhere in the region were not represented in the shelter. In spite of these gaps there is enough evidence to construct at least an outline of Shoshonean prehistory.

Despite a dearth of cultural remains in the most recent occupation level, it can be positively identified as a Shoshone occupation because of the presence of the gray, flat-bottomed pottery known to be a product of Shoshone manufacture (Coale 1963). The radiocarbon date of  $340 \pm 90$  BP for the occupation seems valid.

The small collection of projectile points from Culture Layer 37 provides little basis for interpretation and involves a problem that will be considered in detail below. The layer is considered to be Shoshonean. The fact that it was overlain by and, as will be demonstrated shortly, preceded by occupations identified as Shoshone, suggests that it too can be so attributed.

The large assemblage from Culture Layer 36 contains many items indicative of the Shoshone. Table 12 gives some elements of Northern Shoshone and Bannock culture listed by Steward (1943) that could be found in — or inferred from — an archeological context. The exact use of some items in Layer 36 cannot be precisely determined. These are indicated by a question mark. For instance, the netting could have been used to catch fish, rabbits, or both; the coiled basketry may represent water bottles or cooking baskets.

Some items are not listed for the Northern Shoshone but do occur in other Utaztekan groups. The Skull Valley and Deep Creek Gosiute had the stone axe and hafted knife with wood handle. Flexed burial is noted for the Death Valley Shoshone (Steward 1941:319) but not the Northern Shoshone.

Many traits of the Northern Shoshone were not found in Layer 36; however, the general flavor of Northern Shoshone culture is reflected in the Layer 36 assemblage. Many ethnographic traits are associated with the horse. If these are not considered, the similarity between Layer 36 and Northern Shoshone culture becomes even closer. That we are dealing with the Shoshone of around AD 700 seems certain.

The meager assemblages recovered from Culture Layers 34 and 32 include few items that serve to extend Shoshone culture backward in time; however, rock-filled roasting pits were associated with each stratum. This type of cooking pit appeared in the preceding McKean complex layer and continued in use at least to Layer 36. They appear to have diagnostic value, at least in Wyoming, and were used by the historic Northern Shoshone (Steward 1943:305). In addition, the method of slotting shafts in Layer 36 is noted for Layer 34. Cordage of vegetable fiber is present in both Layers 34 and 32.

The Late Middle Prehistoric period on the Northwestern Plains (Mulloy 1958) would include Layers 34 and 32. The period dates from about 1500 BC to AD 500 and is relatively unknown. One particular site of this period, Spring Creek Cave near Tensleep, Wyoming, contained an assemblage of artifacts including coiled basketry, yucca cordage, bark knots, spirally rasped foreshafts, shaft slotting discards, bone awls, and stone beads. In short, the assemblage is very similar to that in Culture Layer 36, but with larger corner-notched dart points. The occupation is dated at  $2175 \pm 200$  BP (Frison 1965:93). Rock-ringed fireplaces were unearthed in the cultural stratum, but no roasting pits were found.

Several sites in the Shoshone Basin of Wyoming produced projectile points similar to those in Layers 34 and 32 and rock filled roasting pits. Site 48FR33 produced at least two projectile points identical to the major type in Layer 34 (Mulloy 1954a:Fig. 21, Nos. 2, 3). The site has a radiocarbon date of  $3350 \pm 250$  BP (C-711) (Libby 1955:124). This is considerably earlier than the date for Layer 34; however, other projectile points from 48FR33 indicate the presence of a McKean complex occupation, a component similar to that in Layer 36, and possibly others.

Table 12. Comparison of Shoshone and Bannock culture elements with the Culture Layer 36 assemblage.

Element	Lemhi	Ft. Hall	Bannock	Promontory	Layer 36
<b>Hunt</b>	+	+	+	+	+
<b>Net Rabbits</b>	+	+	+	+	+?
<b>Fishing</b>	+	+	+	+	+
Nets	+	-	+	-	+?
Net Sinkers Attached	+	-	+	-	+
Harpoon	+	+	+	+	+?
Spear (prongs)	-	-	-	+(3)	+?
Sinker, Notched Stone	+	-	-	-	+?
<b>Gathering Implements</b>					
Single-Point Digging Stick	+	+	+	+	+
Wood Digging Stick	+	+	+	+	+
<b>Food Preparation</b>					
Meat Pulverizing	+	+	+	+	+
Grind On Metate	+	+	(+)	-	+?
On Any Rock	-	-	(+)	+	+?
Marrow Extracted	+	<b>R</b>	+	+	+
Individual Earth Oven	+	+	+	+	+?
Communal Earth Oven	-	-	+	+	+?
Boiling in Basket	-	-	+	+	+?
<b>Dwellings</b>					
Live in Caves	+	+	+	+	+
Temporary Only	+	+	+	+	+
Sleep on Loose Grass or Bark	+	+	+	+	+
Furs Sewn Together	+	0	+	+	+?
Woven Fur	+	+	+	+	+?
Woven Fur Bed Covering	+	+	+	+	+?
Sewn Fur Bed Covering	+	+	+	+	+?
<b>Fire Making with Compound Drill</b>	+	-	+	+	+
<b>Miscellaneous Implements</b>					
Metates and Mullers	+	+	+	+	+
Thin, Dual Metate	+	+	+	+	+
Oval Muller	0	0	0	+	+
Grinding Back and Forth	+	+	+	+	+
Basketry Water Container	+	+	+	+	?
Knives: Unhafted Flint Blades	+	+	+	+	+
Hafted, Wood Handle	-	-	-	-	+
Broken Cobble for Cutting	+	+	+	+	+
Awls	+	+	+	+	+
Bone	-	-	-	+	+
Wood	+	+	+	-	+?
Drills	+	+	+	+	+
Shaft with Stone Point	+	+	+	+	+
Stone Axe	-	-	-	-	+
Natural Cobble for Hammer	+	+	+	+	+
Flint Flaker	+	?	+	+	+
Sharp Point	+	0	-	+	+
Antler Tip	+	+	+	+	+

Element	Lemhi	Ft. Hall	Bannock	Promontory	Layer 36
<b>Bow and Arrow</b>	+	+	+	+	+
Without Foreshaft	+	+	+	+	?
With Foreshaft	-	+	+	+	+
Cane Shaft	-	-	-	+	+
Feathers, Gum or Pitch Adhesive	+	+	+	+	+
Feathers, Sinew Tied	+	+	+	+	+
<b>Basketry</b>					
Willow Coil Foundation	+	+	+	R?	+
Number of Rods	1	1+	1+	1	1
Pitch-Coated Inside	+	+	+	+	+
<b>Fur Blankets</b>	R?	R	R	+	+
Fur Twisted Into Rope	+	R	R	+	+
Rabbit	+	R	R	+	+
<b>Nets</b>	+	+	+	+	+
<b>Cordage</b>					
Vegetable Fiber	+	+	+	+	+
Sinew	0	+	+	-	+
Two-Ply	+	+	+	+	+
Three-Ply	+	+	+	+	+
<b>Pendants</b>	R	+	0	0	+
Stone	-	+	0	0	+
<b>Necklaces</b>					
Bone Tubes	R	R	+	R	+
<b>Hair Brush</b>	+	+	+	+	+?
<b>Robes and Capes</b>					
Twined Fur Robe	-	-	+	+	+?
Furs Sewn Together	+	+	+	+	+
Mountain Sheep Skins	+	-	-	+	+
<b>Foot Gear</b>					
Moccasin Lining	+	+	+	+	+
Fur Left On For Winter, Turned Inside	+	+	+	+	+
<b>Death Customs</b>					
Dressed in Ornaments	+	+	+	+	+
Wrapped in Blanket	+	+	+	+	+
Burial	+	+	+	+	+
Body Extended	+	+	+	+	-
Head to the West	+	+	+	V	+
Grave Rock Covered	+	+	+	+	+

Notes: R = recent; (+) = occasional practice; V = variable practice; 0 = information insufficient or unavailable.

The lower level of 48FR34 contained a cobble-filled roasting pit and large corner-notched points (Mulloy 1954a:Fig. 14, Nos. 15–17). This occupation is dated at  $3540 \pm 220$  BP (C-702) (Libby 1955:124). The projectile points are somewhat similar to those from Layer 32, but the date is much older.

Site 48FR5 produced points similar to those in Layer 32 (Mulloy 1954a:Fig. 25, Nos. 12–17) and rock filled-roasting pits. Again the radiocarbon date is considerably greater than the Layer 32 date. Hearth charcoal gave an age of  $3506 \pm 220$  BP (C-712) (Libby 1955: 24).

The upper level of the McKean site contained corner-notched points similar to the Layer 32 specimens as well as side-notched indented base and stemmed indented base points (Mulloy 1954b:Fig. 4) and rock-filled roasting pits. This level is dated at  $3287 \pm 600$  BP (C-715) (Libby 1955:125).

I am convinced that these Late Middle Prehistoric period complexes with corner-notched points represent phases of Shoshone culture antecedent to the period represented by Culture Layer 36. The presence of rock or cobble-filled roasting pits at nearly all of these sites ties them to the preceding McKean complex and the succeeding period. The non-lithic assemblage from Spring Creek Cave is strikingly similar to that in Layer 36. Grinding slabs and hand stones are more numerous at the lowland sites. But gathering would be more important here than in the mountains where game seems to have always been plentiful.

The non-lithic artifacts of the McKean complex are much like those in Culture Layer 36. The coiled basketry, netting, and cordage are identical. Woodworking techniques are similar. Rock-filled roasting pits are plentiful. The grinding slab is identical. The chipped-stone assemblages are similar except for replacement of the dart by the arrow in Layer 36.

Although the evidence for the intervening period is meager, change between Layer 30 and Layer 36 is remarkably small and more in the nature of change of a particular type of artifact. I think it safe to assume that the cultural content during the time of Layers 32 and 34 was similar to that of Layer 36 times. Spring Creek Cave provides a look at the period some 500 years prior to the deposition of Layer 36.

The aforementioned problem concerning the projectile points from Layer 37 involves a probable non-Shoshonean culture, and another instance of cultural borrowing seems to be indicated. The projectile points resemble the Avonlea type but are much cruder and generally longer in relation to width than the Avonlea point.

The upper level of the Mangus site in Big Horn Canyon consisted of a thick accumulation of charcoal, burned rock, and artifacts. Of particular interest are the projectile points. These are small rather well made specimens that were identified as a degenerate form of the Avonlea point by Thomas F. Kehoe (personal communication, 1964). Most surprising was the association of one fragmentary Rose Spring Corner-Notched point, coiled basketry, fiber cordage, rock-filled roasting pits and flake end scrapers very similar to those from Culture Layer 36. The general appearance was that of a Shoshonean assemblage but with Avonlea points. Charcoal from one of the roasting pits gave a radiocarbon date of  $1070 \pm 70$  BP (SI-100).

Prior to the excavation of Mummy Cave, the Mangus assemblage was reservedly considered to be a component of the Avonlea complex and to represent a later phase of that manifestation. The Avonlea point was dated at  $1500 \pm 100$  BP (S-45) at the type site (Kehoe and McCorquodale 1961:186). Avonlea points have been reported in northern Montana (Davis 1966), but they appear to be more like the type points and apparently are of comparable age. The Bighorn Canyon points were later in time and significantly different suggesting a related but degenerate form. The Shoshonean-like elements of the Mangus site assemblages were considered as coincidental or the result of borrowing from the Shoshone by Avonlea peoples in contact with them on the Northwestern Plains.

After seeing the projectile points from Layer 37 and learning of the Idaho Blue Dome point, doubts about the interpretation of the Mangus data became stronger. I now feel that the Mangus site assemblage represents an occupation by Shoshone and that the Avonlea complex may have been the instrument by which the small side-notched point was introduced into Shoshone culture and the greater west. The Shoshonean aspects of the Mangus assemblage are too many to ignore, and it is more convincing to view the occupation as Shoshone with Avonlea influence rather than the converse.

Layer 37 probably dates between AD 1000 and AD 1300. The associated projectile points resemble the Mangus specimens but differ from the latter as these do from type Avonlea points being much cruder. The Blue Dome point of Idaho and the Layer 37 points seem to be the same; however, no dating for the Blue Dome point is available.

Examples nearly identical to some Layer 37 specimens were recovered from the Injun Creek site in northern Utah (Aikens 1966:Fig. 22a–e). The site has radiocarbon dates of  $585 \pm 90$  BP and  $345 \pm 100$  BP. The older date may refer to the Avonlea-like points; however, other projectile points suggest the presence of at least two and possibly three components.

The presence of projectile points similar to but significantly different from the Avonlea type in an otherwise Shoshonean complex demands the identification of that complex as Shoshonean and the suggestion that the Avonlea complex was the source from which the Shoshone obtained the small side-notched point appears reasonable. This interpretation resolves a problem encountered in the Big Horn Canyon investigations. Accepting the Mangus material as a component of the Avonlea complex posed the question of what happened to the Shoshone after the Avonlea peoples had vacated the canyon region. It was concluded that the Shoshone were in the region earlier and were displaced by the northern intruders. What little post-Avonlea material recovered was interpreted as the remains of early Crow occupations.

Accepting the latest Mangus occupation as Shoshonean seems more reasonable and provides a precursor for the Mummy Cave Layer 37 points. I now view some of the post-Avonlea material in Big Horn Canyon as Shoshonean and would place it in time between Layers 36 and 38 or about AD 1200–1300. It is surmised that the Shoshone were dominant in the Big Horn Canyon region until the arrival of the Crow from the east, probably not before AD 1500.

These Avonlea-like points provide a precursor for the later points with notches well forward of the base like the specimens from Layer 38. Preceding them in time are the small Rose Spring Corner-Notched points also found in Fremont sites in Utah. Aikens (1966, 1967) hypothesized a Northwestern Plains origin for the Fremont culture and concluded that the Promontory culture (Steward 1937) was actually a complex of northern elements occurring in the Fremont culture on the frontier of Southwestern influence. Sometime after AD 1400 to AD 1600 the Fremont-Promontory people were forced eastward to the Plains by Shoshoneans expanding out of the Great Basin. The Fremont-Promontory then merged with Plains culture and developed a culture represented archeologically by the Dismal River aspect. The implication is that the Fremont-Promontory people were Athabascan.

Husted and Mallory (1967) offered the alternative hypothesis that the Fremont culture developed in Utah from an indigenous Utaztekan-speaking base and that the Promontory culture represents a later phase of this culture. It was concluded that the Fremont culture had no genetic relationships with earlier or later non-Utaztekan-speaking Plains cultures.

It seems reasonable to me that when the Anasazi withdrew to the south and east in the latter 13th century, the Fremont, a horticultural people, would have been forced to give up the growing of food. This of course assumes that climatic deterioration was the principal cause of Anasazi abandonment of large areas and subsequent concentration along the Rio Grande. The Fremont, descended from a hunting-gathering base, would be expected to adapt to the changed conditions, and a return to hunting and gathering appears a reasonable expectation. They may even have migrated into higher country, possibly into Wyoming and Montana. The presence of pictographs and petroglyphs in southwestern and south-central Montana and western Wyoming depicting shield-bearing humans nearly identical to those in the Fremont area of Utah may be evidence of such a movement.

Whatever the events that transpired, much of the material culture recovered at the Injun Creek site (Aikens 1966) is reminiscent of the Layer 36 assemblage, and the projectile points include styles found in Layers 36, 37, and 38 ranging in time from about AD 700 to AD 1600. The Injun Creek radiocarbon dates of  $AD\ 1365 \pm 90$  and  $AD\ 1605 \pm 100$  indicate intermittent use of the site for a considerable period, and the presence of Rose Spring-like points suggests an even earlier occupation. At least one post-horti-



cultural Fremont occupation seems certain. It probably was roughly contemporary with Layer 37 of Mummy Cave. The date of AD 1365 ± 90 may apply to this occupation.

It seems reasonable that the Fremont culture, having many similarities with Anasazi culture yet readily distinguishable from it, can logically represent a people who lived peripherally to the Anasazi and obtained horticulture from them. Both probably were derived from indigenous hunting-gathering cultures. Part of the prehistoric Anasazi culture probably is ancestral to present Kiowa-Tanoan speakers. If the Fremont culture was derived from Utahtekan-speaking peoples, differences between Fremont and Anasazi culture would not be unexpected. With the two living in close proximity, traits of one culture appearing in sites of the other would also be expectable.

The Fremont culture is mentioned in discussions of the upper components of two sites in the Golden-Morrison locality west of Denver, Colorado. These are the LoDaisKa and Magic Mountain sites. The upper component of LoDaisKa was interpreted as an occupation by people of the Fremont culture (Irwin and Irwin 1959:128). The latest occupation of Magic Mountain was considered to be Woodland showing evidence of contact with the Fremont culture (Irwin-Williams and Irwin 1966:212–213).

Of interest are two other sites in the vicinity. Stratigraphic Level 4 of the Willowbrook site is believed to represent a Woodland occupation (Leach 1966:44). A small shelter near Golden, Colorado, a few miles to the north was interpreted as having a Woodland occupation with an overlay of Shoshone traits (Nelson 1967:11).

All of these sites or components contained cord-marked pottery. LoDaisKa, Magic Mountain, and Hall Woodland Cave also produced plain gray sherds attributed to the Fremont, or as Nelson (1967:11) concludes, Shoshoneans. At all four locations, serrated and unserrated Rose Spring Corner-Notched points or variants were the dominant types. At Willowbrook and LoDaisKa, rock-filled roasting pits were in association. Other similarities were noted in the comparisons above and it is here concluded that these sites and components represent Shoshonean (Ute?) occupations, some with the addition of a foreign element in the form of the cord-marked pottery. All are probably contemporary or nearly so with Culture Layer 36 of Mummy Cave, and the radiocarbon dates from LoDaisKa and Willowbrook are comparable.

We have two instances of contact between Shoshoneans and other peoples in the mountains-Plains border area of Colorado and Wyoming. As far as can be determined, both of these meetings took place at approximately the same time roughly AD 600 to AD 800 during the time Rose Spring Corner-Notched points were in use. The type does not seem to occur in significant numbers to the north of the Montana-Wyoming state line on the Plains, and only one or two specimens were recovered from Big Horn Canyon; however, they do occur with some frequency in the Beartooth Range north of the Clark's Fork of the Yellowstone River in southwestern Montana (Vernon Waples, personal communication 1968 and loan of extensive surface collections from the Beartooth Mountains). This leads me to believe that if Shoshoneans had occupied the Northwestern Plains since McKean complex times, their domination of this region was interrupted or ended by the arrival of peoples of the Avonlea complex and so-called Plains Woodland peoples.

It is possible that Shoshoneans could have been forced from the Northwestern Plains at an earlier time. The Vernon Waples collection from the Beartooth Mountains contains many medium to small size rather crudely made side-notched projectile points in considerable variety. Just what these projectile points represent is not known, but their general flavor is different from that of material to the south, and a non-Shoshonean culture probably is involved. Anything beyond mere speculation would be foolish at this point, but the possibility that this western Montana material might be evidence of the prehistoric Flathead or another Salishan people cannot be discounted.

Malouf (1958:109) placed the Flathead, Kutenai, and Pend d'Oreille east of the Rocky Mountains in Montana before the historic period. The Three Forks area and the Bozeman Valley of southwestern Montana form the earliest known center of Flathead life, but by about 1730, the main center had moved westward to the Bitterroot Valley, apparently because of Shoshone pressure from the south (Malouf 1958:111).

Just how long the Flathead occupied southwestern Montana is not known, but the apparent absence or near absence of Rose Spring Corner-Notched points north of Wyoming suggests that at least by AD 600 to AD 800, the Shoshone had, for all intents and purposes, been forced from the Plains of Montana. They may have expanded back onto the Montana Plains, but not if the Flathead or some other group or groups held the territory north of Wyoming.



## Chapter XI: The Great Basin and Birch Creek Valley As Seen From Northwestern Wyoming

The Desert culture hypothesis has been a guiding principle for Great Basin and Plateau prehistorians for more than a decade, and the Bitterroot culture is firmly entrenched in the literature. There has been some criticism that the Desert culture model is not applicable to certain regions or during certain periods of time in these regions (Cressman et al. 1960:69; Daugherty 1962:144; Swanson 1966; Swanson and Sneed 1966:43; Wallace 1962:179), but notwithstanding Jennings' caution that (1957:283), "... the Desert culture hypothesis is useful in direct ratio to the amount of criticism and re-examination it stimulates," the concept seems to have enjoyed an almost unquestioned acceptance and to have become an article of faith. The Bitterroot culture concept rests in a somewhat different light. The investigations in Idaho have been carried out by Idaho archaeologists, and there have been no tests of the hypothesis by outsiders.

A telling argument against the archeological basis of the Desert culture is that of Baumhoff and Heizer who ask (1965:704), "Why is it that so many of the implement forms at Danger Cave are unchanged over a period of thousands of years when such is never the case elsewhere?" This question also may be asked of the Bitterroot culture hypothesis and is aimed squarely at what is considered to be a basic problem in western archeology. The solution of this problem lies in Nicholas Hopkins' (1965:50) statement that, "It is impossible ... to write a prehistory of the Great Basin from data gathered in the Basin alone; a synthesis must be guided by interpretations of data from adjacent regions." A survey of the pertinent literature leaves the impression that each region has its own set of environmental circumstances and unique culture history. One senses that certain regions are viewed as cultural centers from which elements spread to affect or initiate cultural developments in adjoining regions. Obviously this happened to a greater or lesser extent during the past 10,000 years or so, but the picture cannot be as simple as the Desert and Bitterroot culture concepts portray. A completely different interpretation of cultural developments in the west has been presented. Conflicts with the Desert and Bitterroot culture concepts are apparent. It remains to attempt to resolve these conflicts, and in doing so, the Great Basin and Birch Creek will be discussed in turn.

Viewed from the Northwestern Plains, Great Basin prehistory is enigmatic. Developmental sequences are proposed for some regions, while elsewhere, stability and the persistence of traits for thousands of years are claimed. Yet, there is an amazing identity or similarity of material remains over most of the area. This similarity and identity can be extended to the Northwestern Plains from 3000 BC until the time of penetration into the area of peoples from the north and east during the first or second millennium AD; however, on the Plains, the artifacts occur in complexes or assemblages with definite stratigraphic contexts and fairly well established ages. These complexes are not nearly as ancient as the ages ascribed to their Great Basin analogues. In view of the striking resemblance between the material culture inventory of the two areas, the lack of temporal equivalence is incongruous.

The Desert culture (Jennings 1957) is described as a long stable adjustment to an arid environment beginning in the Great Basin by 8000 BC and continuing with remarkably little change into historic times. Throughout this 10,000-year period the climate in the Great Basin is believed to have been essentially like that of today. The Desert culture originated independently of the early Plains big game hunters and spread beyond the borders of the Great Basin at certain times. It is purported to have been the dominant culture on the Plains at the height of the Altithermal, probably from 5000 BC to 3000 or 2000 BC. Wider relationships are suggested, possibly with the eastern Archaic. The twin hallmarks of the Desert culture are the basket and the flat milling stone, the latter said to have been in use by at least 7000 BC.

Of primary interest here is the archeological basis of the Desert culture. At Danger Cave there is no developmental sequence of projectile point forms such as is found elsewhere. Accretion is the keynote, and Jennings (1957:278) says, "The significant thing about the flint collection, however, is that nearly every type or style of flint point persisted throughout the full history of the site."

In Danger Cave, Levels DII through DV contained all of the projectile point types present in the site including stemmed-indent base, McKean Lanceolate, large side-notched, and large and small corner-notched points. Nearly all of these types were found in Level DII which has radiocarbon dates of  $9789 \pm 630$  BP (C-611) and  $8960 \pm 340$  BP (C-64) (Jennings 1957:93). Thus, a majority of projectile points from the cave, appearing elsewhere after 3000 BC, are said to have been in use by at least 7000 BC. The evidence from Mummy Cave and other sites on the Plains and in the Rocky Mountains indicates that the various styles of indented base points did not develop until about 3000 BC or slightly earlier. The sequence is not complete, but a developmental succession of projectile points leading to the indented base forms has been outlined. Such cannot be demonstrated for the Great Basin. Here, numerous styles appear suddenly at 7000 BC or earlier from a cultural base having no spatial or temporal dimensions.

One assumption concerning the spread of Desert culture has immediate bearing on the above. It has been stated that the Desert culture expanded into the Plains during the Altithermal between 5000 and 3000 BC (Jennings 1957:284, 1964:153, 1965:41). Such sites as Birdshhead Cave, Pictograph Cave II, Ash Hollow Cave, Signal Butte, and the lower level of the McKean site are said to evidence this expansion. The McKean complex, if present at all, is the oldest manifestation represented in these sites or components, and radiocarbon dates for McKean complex components demonstrate its appearance no earlier than about 3000 BC. Also of significance is the fact that the McKean complex does not contain large or small corner-notched projectile points, but many were recovered from Level DIII of Danger Cave along with several other styles. Had there been an expansion out of the Basin, one would expect to find a similar cultural content in sites representing the expansion. This is not the case. The various point forms in Danger Cave Levels DII through DV occur in a stratigraphic sequence on the Northwestern Plains beginning at 3000 BC.

Pertinent also is the fact that there is no evidence of significant occupation of the western Plains between about 6000 and 3000 BC. If there ever was a time when people would have left the Great Basin, it would have been during the Altithermal. Yet there is no evidence of such a movement to the Plains. If the western Plains were abandoned during the Altithermal, which seems to be true, the Great Basin, with a less favorable environment to begin with, surely would have been abandoned at about the same time, possibly somewhat earlier. The only conclusion I can draw is that the Great Basin was abandoned by man as Altithermal conditions became too severe for survival.

The evidence for occupation of the Great Basin between 5000 BC and 3000 BC is scant, and in my opinion, not totally convincing. There is the child burial form Leonard Rockshelter (Heizer 1951:92) dated at  $2736 \pm 500$  BP (C-554),  $5779 \pm 400$  BP (C-554), and  $5694 \pm 325$  BP (C-554) (Libby 1955:118). Another burial from Cow Bone Cave, Nevada, is dated at  $5970 \pm 150$  BP (L-289FF) (Broecker and Kulp 1957:1332). A habitation level in Guano Cave, Nevada, has a radiocarbon date of  $6500 \pm 150$  BP (L-596) (Olson and Broecker 1961:153). Since the inner portions of Guano Cave had been mined and the outer portion severely disturbed by vandals (Orr 1952:8), the validity of the radiocarbon date might be questioned. In view of the extent of prehistoric mixture in Great Basin caves (Baumhoff and Heizer 1965:704), a lingering doubt about the actual ages of the burials remains. Nevertheless, three possible cases of human occupation of the Basin during the Altithermal bespeak a great reduction in numbers of a population that does not appear to have been numerous in the first place.

Wallace notes an apparent time gap in the archeological record following the Lake Mohave occupation in the southern California desert. He dates this interval between 5000 BC and 3000 or 2500 BC (1962:175). Lanning's Rose Spring site chronology indicates a similar gap (1963:281). Baumhoff and Heizer (1965) cite a greatly decreased population in the Great Basin with only hints of occupation during the Altithermal and a greatly increased population after 2500 BC.

An early pre-Altithermal occupation of the Great Basin is undeniable but not yet well documented. With the exception of scattered finds of fluted points, the first substantial occupation of the Basin seems to have been that by peoples of the San Dieguito complex; however, this complex appears to be the expression of a hunting culture present when the area had not yet become a desert (Warren 1967:182). The San Dieguito complex appears to be derived from the complex represented at the Lind Coulee site in Wash-

ington (Daugherty 1956). Projectile points of the San Dieguito complex are commonly stemmed, and although generally of cruder appearance, are similar to the Hell Gap and Hell Gap-like points from Lind Coulee. Some San Dieguito complex points more closely resemble Alberta points, also present at Lind Coulee. The occurrence of chipped-stone crescents at Lind Coulee and in the San Dieguito complex supports the derivation.

The San Dieguito complex has two radiocarbon dates of  $8490 \pm 400$  BP (A-724 and A-725) (Haynes, Grey, Damon, and Bennett 1965:10). Since the San Dieguito complex apparently is younger than the Lind Coulee occupation or occupations, a change in projectile point form is to be expected. In view of the tentative nature of the Lind Coulee radiocarbon date, only an estimate of the true age of the site can be made. There are two dates from the Sister's Hill site in Wyoming. One,  $9600 \pm 230$  BP (A-372) (Damon, Haynes, and Long 1964:102), provides an age for alluvial deposition postdating the Agate Basin-Hell Gap occupation. The other,  $9650 \pm 250$  BP (I-221) (Trautman 1964:278), was run on a sample collected from three layers and is the average time the site was occupied. The Alberta layer of the Hell Gap site dates sometime before  $8450 \pm 350$  BP (A-707) (Irwin 1967:202). Because of the presence of both Hell Gap and Alberta points, Lind Coulee must date sometime between about 7700 BC and 6500 BC.

The Lind Coulee site is attributed to big game hunters, and the presence of considerable quantities of bison bone attest to this interpretation. The occurrence of Alberta, Hell Gap, and at least one Agate Basin point (Daugherty 1956:Figs. 19, 20) establishes relationships with the western Plains hunters. The derivation of the San Dieguito complex from Lind Coulee implies that the former was a hunting culture and Wallace's conclusion is substantiated.

The Cochise culture, and particularly the Sulphur Springs stage, is reported to represent an early, desert-adapted culture present in Arizona at the same time as mammoth (Haury 1960). Radiocarbon dates for this stage range from  $6210 \pm 450$  BP (C-511) (Libby 1955:113) to  $8250 \pm 200$  BP (A-69) (Wise and Shutler 1958:74). When first reported (Sayles and Antevs 1941), no projectile points had been found with the Sulphur Springs stage. A few side-notched indented base points were found in Chiricahua Stage deposits along with what appears to be part of a Clovis fluted point (Sayles and Antevs 1941:Plate XI). The indented base points are identical to specimens from Layer 30 of Mummy Cave. More recently it has been reported that projectile points have been recovered from Sulphur Springs stage deposits. They are the same as those found in the later Chiricahua stage (Willey and Phillips 1958:91).

The presence of side-notched indented base points in the Sulphur Springs stage confirms a suspicion that the Cochise culture, or at least the early stage, consists of redeposited artifacts mixed with animal bone from older deposits. Some Chiricahua stage sites may represent primary deposition of artifacts, but others are undoubtedly redeposited as is indicated by the fluted point from Chiricahua:3:16. The location of the Sulphur Springs stage sites in erosion channels in alluvial deposits on alluvial fans does not inspire confidence in the interpretation of the sites as being primarily deposited.

It is here concluded that the Sulphur Springs and Chiricahua stages of the Cochise culture are one and the same. The indented base projectile points indicate the sites are affiliated with the Great Basin counterpart of the Plains McKean complex dating from 3000 BC. Deposits attributed to the Sulphur Springs stage are deemed most apt to be redeposited materials including the bones of mammoth, horse, camel, and other extinct animals from older strata.

With only hunting cultures definitely proven to have been present in the Basin at early time levels and at best only an extremely sparse population on the scene during the Altithermal, a desert-adapted culture could not have been initiated until 3000 BC. With the appearance of the Pinto complex at this time, the base was laid for subsequent developments.

The Pinto complex is included within Irwin-Williams' (1967) Picoso culture along with the Chiricahua and San Pedro stages of the Cochise culture. This construct is offered as the basis of southwestern culture and is basically the same as the hypothesis presented herein; however, the origin, relationships, and later developments of the Picoso differ considerably.

Irwin-Williams derives the Picoso from northern Mexico via the Cochise culture and the San Dieguito materials from the western Great Basin. It is here interpreted that the San Dieguito complex had its origin north of the Great Basin and returned to Oregon and Washington or moved westward into the mountains of California with the approach of the Altithermal. The Cochise culture is considered to be part of the Pinto complex derived from the northern Rocky Mountains at the end of the Altithermal. Irwin-Williams considers similarities between Picoso materials and contemporary complexes elsewhere in the Great Basin to be the result of stylistic diffusion rather than basic cultural unity. I agree that there are differences in what I am calling, for the sake of simplicity, the Pinto complex; however, I consider the various manifestations to be related culturally and linguistically (Utaztekan). Once in the Great Basin and Southwest, the people would be expected to adapt to the various zones within the broad environmental area. Local adaptation would result in differences in the material content of the basic culture. Further discussion of artifact variability in the Pinto complex and its possible significance is provided in a following section.

On the Northwestern Plains, large corner-notched projectile points succeeded the indented base styles of the McKean complex, probably by about 1500 BC. The remainder of the material culture inventory appears to have remained relatively unchanged. The rock-filled roasting pit continued in use, and cultural continuity with the McKean complex is indicated.

In Hunt's (1960) Death Valley sequence, large corner-notched points of Late Death Valley II replace the indented base forms of Early Death Valley II. Phase I of Wallace's (1962) Period III corresponds to Hunt's Late Death Valley II. Although the point collection is small and some mixture is indicated, the Rose Spring site sequence (Lanning 1963) lends support to Hunt's and Wallace's sequences. Small corner-notched arrowpoints identical to and similar to the Rose Spring Corner-Notched style in Layer 36 succeed the large forms and are, in turn, followed by triangular arrowpoints, some with side notches and some with side and base notches. This sequence occurs in Mummy Cave, sites on the Northwestern Plains and in southern Idaho. I can only conclude that this similarity indicates cultural relationships are present over the entire area where this sequence is found.

The Birch Creek sequence, upon which the Bitterroot-Northern Shoshone hypothesis is based, consists of five phases said to form a continuum. According to Butler (1966:117), these are:

Lemhi	AD 1200 – AD 1840 or 1860
Blue Dome	AD 400 – AD 1200
Beaverhead	BC 1000 – AD 400
Bitterroot	BC 5000 – BC 1000
Birch Creek	BC 7000 – BC 5000

Large lanceolate projectile points with smoothed edges characterize the Birch Creek phase. Toward the end of this period, large side-notched projectile points diagnostic of the Bitterroot phase appear, apparently in association with the lanceolate points. The succeeding Beaverhead phase is associated with Bitterroot points of the earlier phase as well as stemmed indented base and corner-notched points. The latter form predominates in the Blue Dome phase. The Lemhi phase is characterized by Desert Side-Notched points.

The Birch Creek continuum is like the archeological Desert culture in that projectile point types or styles appear early and persist for lengthy periods. Concerning the five Birch Creek phases, Butler (1966:117) states: "They share many traits in common and are distinguishable from each other primarily on the basis of changes in the frequencies or proportions of point types."

Swanson, Butler, and Bonnicksen (1964:99, Table 2) list the percentages of projectile point types per phase at Veratic Rockshelter. With three exceptions, each type is assigned to the Birch Creek, Bitterroot, Beaverhead, and Blue Dome phases. Squat lanceolate and corner-notched points are not present in the Birch Creek phase, and no lanceolate points occur in the Blue Dome phase. The type characteristic of a particular phase occurs in greatest numbers in that unit and is found in earlier and later phases in lesser

numbers. Thus, Bitterroot, Elko Eared, and stemmed, indented base points are reported as having minimum life spans of at least 5,000 years!

The Birch Creek Valley sequence is nearly identical to that at Mummy Cave, and similar culture histories are evident. In both regions the projectile point sequence progresses from lanceolate to early side-notched to indented base to large corner-notched to small corner-notched to small side-notched points. The only difference is the presence of varieties of side-notched indented base and stemmed points in Mummy Cave dating between about 4500 BC and 3300 BC, which apparently are not represented at Birch Creek. Three specimens from Alpha Rockshelter, further north on the Salmon River, are similar to the stemmed points from Layer 24 but may or may not be of the same type (Swanson and Sneed 1966:Fig. v-x).

A major point of conflict between the Mummy Cave and Birch Creek sequences is that the latter is said to demonstrate a cultural continuum, while Mummy Cave is interpreted as containing a series of ultimately related occupations interrupted by the intrusion into the region of a group from the eastern Plains or beyond. The Mummy Cave sequence is unequivocal. Lanceolate points are gone by about 6000 BC, being replaced by Blackwater and Pahaska Side-Notched (Bitterroot) points. By about 4500 BC the side-notched form is replaced by certain styles of indented base points which continued to about 3300 BC along with a few stemmed points. By 2500 BC the McKean complex appeared with a variety of side-notched indented base, stemmed indented base and McKean Lanceolate points. Large corner-notched points were present by 800 BC and were replaced by small corner-notched arrowpoints by about AD 700. Small side-notched points appeared at about AD 1000 to AD 1300.

In the Birch Creek sequence, identical projectile points are present, with the above mentioned exception, but are accorded life spans of up to 5,000 years or more. Frankly, I cannot accept this, and conclude that a culture history nearly identical to that at Mummy Cave took place in the Birch Creek Valley some 160 miles to the west.

Swanson apparently sees the Rocky Mountains as a homeland or center from which a basic culture spread to adjacent regions. If I understand him correctly, the Bitterroot culture or phase and the early Birch Creek phase represent technological transformations within the basic culture. Swanson (1962) postulated a Mountains-Plains culture adapted to the mountains parks and valleys and the adjacent Plains. He sees fluting as an adaptation to the taking of large mammals (mammoth, bison) and non-fluted points as being associated with smaller game and states (1962:155) that, "Points of Eden type are then later indices of the same culture adapted to hunting of migratory animals that spread from the forested mountain regions with the passing of the larger forms." In a later statement Swanson and Sneed (1966:43) suggested that, "One possibility is that early Plains lanceolate points are only a tool-making complex associated with particular types of hunting. If so, the Bitterroot pattern represents a transformation in technology associated with the evolution of modern forms of bison and other mammals found on the dis-climax grasslands of eastern Idaho." However, that the Bitterroot pattern might have entered Idaho from elsewhere is considered briefly (Swanson and Sneed 1966:43).

I agree that the central and northern Rocky Mountains were the homeland of a culture, but rather than being a more or less homogeneous interacting unit, also present on the Plains, I see it as a mountain-adapted culture that had its roots on the Plains. Contacts with the Plains hunters probably were maintained to some extent, but this mountain-adapted culture is viewed as a more or less distinct entity after its separation from the Plains hunting culture until about 6000 BC to 5500 BC.

The early side-notched projectile point obviously is derived from the east and appears as an intrusion in the Rocky Mountain archeological record. A population distinct from the resident mountain-adapted people is involved and must be taken into account. The appearance of the side-notched style further west, in the Cold Springs horizon above Mazama ash dated at about 4600 BC, is considered by Swanson (1962:156) to be the result of either a diffusion of a trait complex or a population movement. At the Weis Rockshelter (Butler 1962), 21 early side-notched points were recovered from Stratum 3, which overlay an



accumulation of Mazama ash. Stratum 5a, immediately beneath the ash, produced 15 Cascade points, and 11 more were found in Stratum 5c.

The occurrence of early side-notched points in strata overlying Mazama ash has been demonstrated at sites in eastern Oregon and Washington. This relationship occurred at Wild Cat Canyon (Cole 1965), Hobo Cave (Cressman and Cole 1962), Marmes Rockshelter (Fryxell and Daugherty 1962), Thorn Thicket (Sprague and Combes 1966), and Cold Springs (Shiner 1961).

The layer of Mazama ash found over a wide expanse of the northwest is dated by radiocarbon at about 4600 BC (Fryxell 1965:1288). The early side-notched point is then somewhat more recent in the Columbia-Snake River region. At Hobo Cave, the side-notched points occurred above Mazama ash and beneath deposits dated by radiocarbon at  $6125 \pm 250$  BP (Cressman and Cole 1962:31).

Cascade points are about 8,000 years old as is indicated by radiocarbon dates. At Cascadia Cave they are dated at  $7910 \pm 280$  BP (Newman 1966:23),  $7990 \pm 220$  BP at Three Sheep Rockshelter (Ross 1963:59) and  $7940 \pm 150$  BP at Ash Cave (Butler 1962:71).

Accepting radiocarbon dates of  $7340 \pm 140$  BP for Stratum 5g and  $4650 \pm 70$  BP for Stratum 5a of Weis Rockshelter, Butler calculated terminal dates of about 1480 BC for Stratum 5a and 95 BC for Stratum 3 and concluded that the ash layer was redeposited Mazama ash. Considering the age of Cascade points at other sites, the dating of Mazama ash at about 4600 BC, and the position of early side-notched points above this ash at sites in the same region, Butler's dating and conclusions are difficult to accept. A more reasonable and logical solution would be to reject the radiocarbon dates rather than accept them and reconcile the stratigraphy and artifact associations in direct opposition to dates and sequences from several sites not too far distant.

Some of the side-notched points from Weis Rockshelter are identical to those from Layers 17, 18, and 19 of Mummy Cave, but others have considerably wider notches (Butler 1962:Fig. 9ss). Those from the Oregon and Washington sites tend to be generally more crudely fashioned. Since a span of several hundred years separates the Mummy Cave and Oregon-Washington occupations, changes in point form are to be expected. In any event, the Cold Springs horizon provides continuity for the early side-notched point found in Mummy Cave from about 5700 BC to about 4900 BC.

It is maintained that the Bitterroot Side-Notched point persisted at Birch Creek in an intergrading sequence to the historic period and Swanson (1962:155) says, "Although distinctive types of side-notched points can be recognized, such as Avonlea, Desert, and Northern, they intergrade so well that they constitute one historical type ..." At Mummy Cave there is continuity of the trait of side notching from about 5700 BC to the McKean complex layer. Then this trait is absent for some 3,000 to 3,300 years until it appears again in Layer 37; however, it has been interpreted here that the makers of the side-notched points in Layers 16 through 19, and those making the points from Layer 21 on were of unrelated populations.

Elko Eared points are reported to accompany side-notched points in the Birch Creek sites, and Pinto points are said to be present in earlier occupations but do not continue into the later prehistory of the region (Swanson 1962:155). Data from Mummy Cave and elsewhere demonstrates that the particular stemmed indented base (Pinto) point found in Birch Creek did not evolve until about 3000 BC. The same is true for the eared point. The situation is the same with the later Birch Creek occupations.

In view of the near identity between the materials present in the Birch Creek and Mummy Cave sequences, the similarity of environments, and the fact that both regions are within historically known Shoshone territory, the Birch Creek sequence cannot be reconciled with that at Mummy Cave. There is no persistence of side-notched points in an intergrading sequence into the historic period; lanceolate points disappear by about 6000 BC; the McKean complex projectile points are not present until after 3000 BC and are replaced by corner-notched points at least by 800 BC. Small corner-notched arrowpoints appear by 700 AD and are replaced by small side-notched points by about AD 1000 to AD 1300. The sequence from McKean complex times on has been demonstrated again and again at sites on the Plains, and I sim-

ply cannot conceive of Birch Creek as a unique region with its own culture history distinct from that of a nearby region containing nearly identical archeological materials.<sup>14</sup>

A cultural continuum is not present in Mummy Cave, but the stratigraphically separated layers are considered to represent a continuum of culture in the region from at least 4400 BC to about AD 1600. The most recent occupation is identified as Shoshone, and the preceding occupations back at least to Layer 30 are also considered to represent Shoshoneans. This archeological sequence is not confined to the Plains and southern Idaho but is found over most of the Great Basin, or in other words, much or all of the historically known Utaztekan-speaking area in the United States. There are regional and local differences to be sure, but the basic succession of projectile point types as well as other implement forms is present and cannot be dismissed.

The evidence from Mummy Cave indicates that Shoshone culture is traceable backward in time to the McKean complex and ultimately to the early mountain-adapted and late Plains Paleoindian hunting cultures. The early side-notched point disappeared from the Mummy Cave region by 4500 BC but may have been present in Birch Creek at a later time but not after 3000 BC. The fact that they appear to the west above Mazama ash leads me to suspect that the eastern derived population moved out of Birch Creek considerably earlier than 3000 BC.

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<sup>14</sup> *Senior Author's Note.* It has subsequently been determined that Swanson included multiple occupations and cultural features within gross natural strata (Lohse and Sammons 1994:36). This explains the apparent longevity of projectile point types in the Bitterroot culture.



## Chapter XII: Western American Archeology and Language: A Hypothesis

The reconciliation of archeological assemblages with linguistic groups is hazardous. One attempt at this procedure (Taylor 1961), although lauded for its boldness, received considerable criticism (Hopkins 1965; Jacobsen 1966; Miller 1966). However, Taylor's hypothesis did not link language with any specific archeological assemblages. It was, rather, an attempt to reconcile glottochronological dates and language distributions with Desert culture. Swanson has hypothesized that the Bitterroot culture is the archeological counterpart of the Northern Shoshone who speak a Utaztekan language. Its validity has not been demonstrated, and full exposition of the evidence remains to be published. Since the one attempt at relating archeology to language and the criticisms of this attempt involved the Desert culture concept, here considered to be an invalid construct, the reliability of the procedure is yet to be demonstrated.

An interpretation of western prehistory differing largely from the Desert and Bitterroot culture concepts has been presented. The archeology is not as clear as I would like it to be, but certain correspondences between archeological and linguistic evidence appear to be the result of more than mere coincidence. The following hypothesis (Husted 1968, 1995; Mallory 1968) based on these correspondences conflicts with the generally accepted historic reconstruction of the Utaztekan languages (Lamb 1958) but supports Taylor's (1961) hypothesis. It differs from the latter mainly in the dating of particular events and was developed before the evidence from Mummy Cave was obtained. To my satisfaction, these data supported previous thinking and led to expansion of the original model.

It is proposed that Macro-Hokan speakers represented by the western Llano complex occupied the Plains between 9500 and 9000 BC. At about 8500 to 8000 BC these people, represented by the Folsom complex, were forced into the southern Plains by the arrival to the north of Macro-Penutians represented by the Agate Basin complex. In the meantime, small numbers of Hokans probably had ventured into the Great Basin and probably westward into California and Baja California.

Soon after arriving in the northern Plains, about 8000 BC, one group of Macro-Penutians moved westward into Oregon and Washington (Proto-Penutians), and another group (Proto-Aztec or Tanoan) moved into the central and northern Rocky Mountains of Idaho, Montana, and Wyoming and adapted their culture to that environment. Sometime between 7000 and 6000 BC the Plains group (Proto-Aztec or Tanoan) began a northward migration with the approach of the Altithermal and by about 5500 BC moved into the Rocky Mountains of southern Alberta and British Columbia. Between 6000 and 5500 BC, a Mosan-speaking population crossed the Plains from the Iowa-Nebraska area and moved into the central Rocky Mountains displacing the mountain adapted Proto-Aztecs or Tanoans somewhat to the north.

From the Oregon-Washington area Penutians entered the Great Basin, probably not long after their arrival in the northwest. They are represented in the Great Basin by sites of the San Dieguito and related complexes. With the approach of the Altithermal, these Penutians either moved westward into or across the mountains into California or withdrew northward to Oregon and Washington leaving the Great Basin essentially abandoned.

Ultimately, the Mosan speakers in the Rocky Mountains moved westward arriving in the Columbia Plateau region shortly after the eruption of Mount Mazama around 4600 BC. The mountain-adapted Proto-Aztecs or Tanoans then moved back into the central Rocky Mountains after the Mosans had vacated the region.

At 3000 BC, the end of the Altithermal, the Aztec-Tanoans moved out of the northern Rocky Mountains onto the Plains and into the Great Basin. Some remained in the Rocky Mountains of Idaho, Montana, and Wyoming. They occupied these areas to the historic period with the exception of the Plains where late prehistoric population shifts forced them westward into the mountains.

Some Penutians probably moved into the Great Basin at the end of the Altithermal. They may be represented by archeological sites containing Gypsum Cave points. It is suggested that these sites may represent the ancestral Zuni.

Sydney Lamb (1958:99) proposed that, "Around five thousand years ago, Proto-Utaztekan was slowly beginning to spread out into a number of dialects. It may have been located somewhere in the neighborhood of the boundary between Arizona and Sonora." Subsequently, the Numic or Plateau Shoshonean languages emerged in the southwestern Great Basin and, not until about 1,000 years ago, did the Numic speakers spread north and east to occupy the historically known Numic-speaking area. Lamb concluded that until about 1,000 years ago, the Great Basin is unaccounted for linguistically and suggested that the area may have been occupied earlier by speakers of other languages which moved elsewhere or by speakers of other languages who remained and adopted a Numic language. Lamb suggests (1958:100) some of the extinct languages "... may have been Utaztekan, but they could just as well, or perhaps more likely, have been languages related to Hokan, Zuni, Keres, Algonkian, or even some stock now totally extinct."

Walter Taylor (1961) proposed a northern origin for Utaztekan. He hypothesized an early occupation of the Great Basin by Hokaltecan speakers of the Desert culture. Later, but possibly as early as 8000 BC, Penutians entered the Great Basin from the north and may have been split by encountering Hokaltecan already in the northern Basin. He proposes a Macro-Penutian consisting of Penutian and Utaztekan, and cites Swadesh's (1959:10) internal divergences of 100 maximum centuries for Penutian and Macro-Nawan as possibly indicating a divergence of Utaztekan from Penutian. Taylor has the Utaztekans continuing southward along the mountains leaving remnants along the way and sending offshoots into the lower lands. Apparently this was taking place during the Altithermal prior to 3000 BC. Taylor (1961:77) states that:

... it is a virtual certainty that this 'main body' would itself have been a composite agglomeration involving a number of already distinct but related linguistic entities and that the separation of remnants was a continuing process covering a considerable temporal and geographic span.

Hopkins (1965) presented the alternate hypothesis that as the Altithermal began, two major branches of Utaztekans moved southward from the northern Great Basin, one down the western flanks of the Rockies and one along the eastern Sierras. With the Medithermal, the Numic or northernmost Sierran branch began to move into the Great Basin but were retarded from occupying the Basin proper until about 1,000 years ago by horticulturalists. This supports the southern expansion of Utaztekan proposed by Lamb (1958).

Based purely on linguistic evidence, a southern homeland for Utaztekan appears reasonable, but a spread of the Numic languages at only 1,000 years ago and the necessity of explaining away a 4,000-year archeological continuum seems much too complicated in view of the geographic extent of the pre-AD 1000 archeological complexes and the apparent great numbers of sites of each particular phase. The archeological sequence in Death Valley, the region or near the region from which the Numic speakers are supposed to have spread, is practically identical to that elsewhere in the Basin. This would support a southern origin of Utaztekan but is in conflict with a late expansion of Numic. However, there is no demonstrated archeological sequence in the southern Great Basin between about 7,500 and 5,000 years ago which removes that region as a homeland for Utaztekan.

I suspect that an extremely complex origin of the Aztec-Tanoan languages and mass population movements many millennia in the past resulted in a situation giving the appearance of a southern origin for Utaztekan, when actually, Utaztekan spread from the northern Rocky Mountains. Wick Miller (1966:91) describes the Utaztekan languages as, "... a classic example of a language family that originated as a group of dialects which slowly dissolved and diverged into a number of branches; there is little evidence of abrupt splitting off. In going from north to south, each branch has more in common with continuous branches than with those once or twice removed. The gradation is not entirely even, as seen by the Sonoran and Shoshonean groupings that seem to reflect closer dialect inter-influence at an earlier time." He illustrates (1966:Fig. 1) three kinds of linguistic family trees, all of which lead to similar results. These include a dialect continuum, two early dialect continuums, and intermediate proto-languages. Miller (1966:82) states that, "It may be impossible to tell if geographically intermediate dialects have become extinct or were absorbed (Fig. 1a), if there were two early dialect continuums (Fig. 1b), or if two

intermediate proto-languages are to be assumed (Fig. 1c). The Shoshonean grouping may represent such an ambiguous situation.” Miller’s Figures 1b or 1c reflect the archeological situation in the northern Rocky Mountains prior to 3000 BC as interpreted above.

In the comparison of archeological and linguistic data, uncorrected radiocarbon dates and lexicostatic dates cannot be equated because of the variation in radiocarbon activity beyond 500 BC. The critical period in the interpretations to follow has a radiocarbon age of about 5,000 years. In reality, a radiocarbon age of 5,000 years corresponds to a true age of 5,800 to 6,100 years (Ferguson 1958:845; Stuiver 1967:37). Thus, the spread of the McKean and Pinto complexes at 5,000 radiocarbon years actually began closer to 6,000 years ago. In order to avoid confusion, I will continue to use uncorrected radiocarbon ages and a figure of 5,000 years for the appearance of the indented base projectile point, but it should be kept in mind that the spread of the McKean and Pinto complexes probably began soon after 4000 BC.

Taylor (1961) hypothesized that the early Basin inhabitants were Hokan speakers practicing Desert culture. Husted and Mallory (Husted 1995) reject the early appearance of Desert culture, but this is not a critical point. It is agreed that Hokans were present on the southern Plains and probably to the west in the southern Basin and California. Whether they formed a continuous band across the southern Basin is not important. Some Hokans probably passed on through Mexico at least to Central America, and more probably into South America. They may or may not have occupied all of the southern Great Basin. There is little evidence of their presence to the north.

The arrival of the Macro-Penutians must have forced the Plains Hokans southward. At any rate, some Macro-Penutians probably continued on southward into Mexico. Mayan and its relatives might be included in a Macro-Penutian (Spencer and Jennings 1965:109), and if the relationship is proven, a Hokan continuum across the southern Basin could have been broken by about 8000 BC.

The arrival of Macro-Penutians is equated with the appearance of the Agate Basin complex on the Plains between 8500 and 8000 BC. Some would derive this complex and its later derivatives, the so-called Plano complexes, from the earlier fluted point complexes on the basis of stone technology; however, for a number of reasons we concluded that the Agate Basin complex represented the arrival of a new people in North America. The possibility that the Agate Basin complex was related to the fluted point complexes at an earlier level was not discounted.

The Agate Basin complex, or probably more properly, a phase of this complex appears in Oregon and Washington at such sites as Lind Coulee, Five Mile Rapids, Fort Rock Cave, and Cougar Mountain Cave. The data from the latter site are highly suspect, but the presence of Agate Basin, Hell Gap, and Alberta points in the lower levels places the Agate Basin complex and succeeding phases in the area. This manifestation arrived in the Pacific Northwest probably by about 8000 BC, maybe a bit later. The maximum internal divergences of Penutian and Macro-Nawan are given as 10,000 years (Swadesh 1959:10). Thus, the movement of part of the Agate Basin complex to the Pacific Northwest corresponds in time to the postulated divergence between Penutian and Proto-Aztec-Tanoan. Taylor (1961:75) places the split in the mountains north of the Great Basin. We place the region of the split on the northern Plains of Montana and/or Wyoming. The Snake River Plain of Idaho is suggested as the route into the Pacific Northwest.

The divergence between Aztec and Tanoan may have taken place at 8000 BC, as is suggested by Swadesh’s lexicostatistic date. Miller (1966:86) stated it was likely that Aztec-Tanoan was in the area of the Desert culture by 10,000 years ago or shortly thereafter. The early levels of Mummy Cave, Layers 8–14, are interpreted as a mountain-adapted culture derived ultimately from the Agate Basin complex. Layers 1–7 may represent earlier phases. If so, this culture was already in the mountains by 7500 BC.

At this point, 8000 BC, we have Proto-Penutians in the Northwest, and Proto-Aztecs and Proto-Tanoans on the Plains and in the central and northern Rocky Mountains. Whether the Aztecs or the Tanoans remained on the Plains or went into the mountains is undetermined.

On the Plains, there were a series of post-Agate Basin complex developments. The sequence at the Hell Gap site progresses from Agate Basin, to Hell Gap, to Alberta, to Cody complex. The relationship of

the Frederick level found above Cody complex artifacts is not known at present. Probably during Cody complex times, a northward migration to Canada began with the approach of the Altithermal. Probably by 6000 to 5500 BC, these peoples moved westward into the Rocky Mountains of southern Alberta and British Columbia. During the same period, an eastern population crossed the Plains and moved into the central Rocky Mountains of Montana and Wyoming displacing the mountain-adapted peoples northward, probably to central and northwestern Montana. The eastern group represented by projectile points identical to those from the Hill, Logan Creek, and Simonsen sites of western Iowa and eastern Nebraska appeared in Mummy Cave at about 5700 BC.

It was suggested that the eastern population were Mosan or Proto-Mosan speakers on their way to the Columbia Plateau. The time depth of Mosan is about 9,000 years (Swadesh 1953:26–27). Their appearance in the Rocky Mountains, apparently soon after 6000 BC, indicates that divergence from the proto-language began to the east before crossing of the Plains. Sapir's (1929) Mosan-Algonkian relationship is in accord with an eastern origin of Mosan, and the time depth of Mosan will allow its equation with the early side-notched projectile points.

By at least 6500 BC, Penutians had entered the Great Basin from the north. Their presence is equated with the San Diequito complex (Warren 1967). This complex was related to that at the Lind Coulee site, and it was concluded that San Diequito was a later phase. A Hokan continuum across the southern Basin could have been broken by this expansion of Penutians but need not necessarily have happened at this time. As the Altithermal approached, it was suggested that the Great Basin Penutians either withdrew westward into California or returned northward to Oregon or Washington, thus leaving the Great Basin virtually abandoned. A westward retreat could account for the presence of the California Penutians.

Back in the Rocky Mountains, the Mosans moved on westward appearing along the Snake-Columbia River region, probably not long after the eruption of Mount Mazama at about 4600 BC. The side-notched points in the Cold Springs horizon are, in some cases, identical to those in Culture Layers 16 through 19 of Mummy Cave, but most have wider notches indicating some change had begun since leaving the eastern Rocky Mountains.

Eventually, the displaced mountain-adapted peoples moved back into the central Rocky Mountains vacated by the Mosan speakers. Earlier, it is thought that the northward displacement probably put them into contact with the group that had entered the northern Rocky Mountains from the Canadian Plains. With the Proto-Aztecs and Proto-Tanoans in contact once again, some linguistic convergence may have taken place; however, with some 2,500 to 2,000 years of separation, assuming the split occurred at 8000 BC and the northward displacement at 6000–5500 BC, language divergence would have been considerable. But the possibility of some degree of convergence cannot be discounted.

At the end of the Altithermal, the Aztec-Tanoans spread from the Rocky Mountains onto the Plains and into the Great Basin. Lexicostatistic dating of internal divergence within Utaztekan of 40 to 50 minimum centuries is in agreement with this expansion. It was concluded that the Plains McKean complex and its Great Basin counterpart, the Pinto complex, document the Aztec-Tanoan expansion. The presence of three styles of indented base projectile points and probably variation within other artifact classes yet to be determined lend the impression of heterogeneity and may well reflect language differences within the population. The proposal of related Plains and mountains populations certainly is in agreement with an Aztec-Tanoan divergence.

The move from the northern Rocky Mountains must have been total with the entire population moving out, probably southward down the Plains. The complete vacating of an area suggests pressure from another people. Athabascans entering Canada may have been the cause of the migration. Swadesh (1960: 731) gives 47 centuries as the divergence of Nadene. This is in close agreement with the divergence of Utaztekan and the appearance of the McKean and Pinto complexes.

With the Plains and Basin unpopulated, there would have been no barriers to the expansion of the Aztec-Tanoans, and the movement of an entire people from one place to another becomes credible. The Aztec-Tanoans may have encountered Yumans expanding northward up the Colorado River at this time. It

is also possible that the Washo occupied the territory around Lake Tahoe at this time. With the Great Basin up for grabs, so to speak, anyone could have moved in until most of the area was spoken for. If there ever was a Hokan continuum in the southern Basin it certainly would have been disrupted by penetration of the Aztekans heading southward.

Some Penutians may have entered the Basin at about 3000 BC. The apparent appearance of Gypsum points in Pinto complex sites and in a pure context indicates the presence of another people. Husted and Mallory (Husted 1995) suggested that these stemmed points are derived from the southern Oregon region. If these projectile points do represent a Penutian speaking population, it is possible that the prehistoric Zuñi may be involved. Swadesh (1954:1956) placed Zuñi in the Penutoid phylum and Newman (1964) presented evidence to support the relationship; however, definite proof of a linkage was not claimed. If a relationship between Zuñi and California Penutian does exist, it is remote, and Newman placed the divergence of Zuñi and Yawelmani Yokuts at about 70 centuries. He qualified this dating because of a low percentage of common retention. He found nine possible cognates that might be due to chance resemblance (Newman 1964:2).

Romney (1957:39) described the early Utaztekans as a highland people but placed their homeland in the upper Gila River area. Taylor (1961:75–76) concluded that originally the Utaztekans were a mountain or highland people. As interpreted by Husted and Mallory (Husted 1995), the Proto-Aztecans and Proto-Tanoans spent some 2,500 years in the central and northern Rocky Mountains before moving to their historically known regions. One of the groups had adapted itself to a mountain environment possibly 10,000 years ago.

Lamb's conclusion that the homeland of Proto-Utaztekan was near the Arizona-Sonora border (1958:99) is certainly reasonable since the determination was made on purely linguistic grounds. Given the archeological situation as interpreted above, it would be impossible to determine a total migration of a language from one area to another using only linguistic concepts. If the interpretations and linguistic correlations presented here are valid, a complete and total migration from the northern Rocky Mountains to the Southwest and Great Basin by Aztec-Tanoans took place beginning at around 3000 BC.

Lamb's appraisal of investigations on the breakdown of Utaztekan suggests eight or nine families within the stock, which "indicates a complex dialect area shortly after the time of Proto-Utaztekan, rather than a simple splitting into two or three branches" (1958:95–96). It is not impossible that this divergence took place during the move to the Great Basin or had already occurred in the northern Rocky Mountains before the migration began. The lexicostatistic date of 47 centuries of divergence within Utaztekan is probably a minimum date and could well be too recent by several centuries. It is difficult to accept that some divergence would not have taken place before or during the movement southward.

The heterogeneity of projectile point styles within the McKean complex is suggestive of group differences that further suggest the possibility of linguistic differentiation. Some sites and components contain several point styles, such as in Mummy Cave Layer 30, while at others, apparently pure or nearly pure types are present. Three bison traps in north-central Wyoming and adjacent Montana are illustrative of this situation. These sites, 24PR5 (Bentzen 1961), 48SH311 (Bentzen 1962), and 48SH312 (Frison 1968) contained side-notched indented base projectile points of a variety found more commonly in the Great Basin. With a few exceptions, all the points from these sites belong to a single variety or type. Another example is the side-notched indented base points from the Oxbow Dam site in Saskatchewan (Nero and McCorquodale 1958) and the Long Creek site, Levels 8 and 7 (Wettlaufer 1960). These differ in form from those in the bison traps but are of equivalent age. The occurrence of both varieties in Layer 30 of Mummy Cave demonstrates that the two are related. Other examples could be mentioned, but a perusal of reports on McKean and Pinto complex sites will illustrate the point I am trying to make.<sup>15</sup>

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<sup>15</sup> *Senior Author's Note:* As mentioned above, Yonkee points have now been shown to date around 3,000 years ago or slightly later. However, I still believe that they are part of the McKean complex and represent a late, possibly localized, terminal phase of this manifestation.



The diversity of point varieties seems to be greater on the Plains than in the Basin. The side-notched indented base point appears to occur in greater number and variety on the Plains while the stemmed-indented base point seems to dominate in the Great Basin. The McKean Lanceolate (Pinto Shoulderless) point is found in both areas in association with the side-notched indented base and/or stemmed indented base points. The relationships must be complex but the general impression is one of diversity within a related population, and linguistic diversity probably can be predicted.

Given the presence of a Utaztekan continuum in northwestern Wyoming for at least 5,000 years and occupation of the region in historic times by Numic speakers, either Lamb's conclusion that Numic speakers spread northward across the basin only 1,000 years ago is invalid or other Aztec-Tanoan-speaking peoples vacated the region allowing the Numic speakers to move in. One possibility is that Numic speakers have inhabited the area for several millennia. In this regard, Jacobsen (1966: 261) stated:

In connection with the problem of the spread of the Numic languages, it is important to keep in mind the *caveat* pointed out by Miller [1966] later in his paper (pp. 103–105) — the fact that dialectological studies are scarce for peoples living a seminomadic life such as that of the Great Basin Indians. Insofar as the moving about of these peoples has tended to maintain a uniformity of speech over relatively large areas, we may be overestimating the recency of the spread of the Numic dialects over the greater part of their area.

This seems to be the best alternative, but is not necessarily the true one.

The presence of McKean complex projectile points in Canada as far east as southern Manitoba indicates that Aztec-Tanoans occupied a large area of the Canadian Plains. How long they remained to the north is not presently known, and the appearance of the McKean complex may represent only the migration to the south; however, the possibility remains that some Aztec-Tanoans may have occupied the northern Plains for a considerable length of time.

Medium size to large corner-notched projectile points replaced the McKean and Pinto styles in the Great Basin and Plains. Similar forms are found in Alberta (Wormington and Forbis 1965:Figs. 23d, 68d, 70d–g, 72c). To the south, radiocarbon dates place the corner-notched styles between about 1500 BC and AD 500. It is thus possible that Aztec-Tanoans remained far to the north of their historically known area at least until around AD 0. If so, the immediate explanation for their subsequent disappearance from the northern Plains would be pressure from other peoples.

If some Aztec-Tanoans remained to the north on the Canadian Prairies, it is possible that they and the peoples in northwestern Wyoming spoke the same dialect of a non-Numic language. When they did finally move southward those in Wyoming could and probably would have accompanied them. Tradition places the Kiowa in western Montana until they moved southeastward to the country of the Crow (Mooney 1898:153). Just when the Crow arrived in Montana has not been decided, but I would estimate not before the 16th Century. Mooney mentions (1898:153) Keim's statement that the home of the Kiowa was in the far north and that wars forced them to move southward.

Kroeber (1939:48) seems to have preferred a southern origin for the Kiowa because of the relationship between Kiowa and Tanoan, and apparently would have them moving northward up the Plains and returning to the southern Plains at a later time (Kroeber 1939:80). With the Aztec-Tanoans originating in the north, as interpreted here, the Kiowa could have remained in the northern Rocky Mountains and/or the northern Plains until their traditional trek southward. Davis (1959:77) places the separation between Kiowa and Tanoan at a little more than 4,000 years ago, and Miller (1966:79) accepts this dating as being more probable than the split at somewhat before AD 1000 given by Trager and Trager (1959:1078). The considerable depth of Kiowa-Tanoan reduces the validity of a conclusion of a southern origin on the basis of linguistic relationship and geographic proximity.

I prefer the alternative that the ancestors of the Numic speakers have been in the Mummy Cave region since at least 3000 BC. The similarity of the archeological sequences in the Basin and the Northwestern Plains from 3000 BC on is in agreement with the presence of a homogeneous population in frequent or close contact.

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## Appendix: The Mummy Cave Tetrapods

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### MATERIALS AND METHODS

Several thousand bone fragments from Mummy Cave were received in the early summer of 1967 for identification and interpretation. Most fragments were small and unidentifiable or identifiable only in such general terms as to supply no useful data. Over 2,000 bones, however, were identified to a useful taxonomic level.

The original specimen catalogues are stored permanently at the Museum of Arid Land Biology; catalog numbers X5001 through X7028 are applied to the Mummy Cave specimens. The bones, identified and otherwise, are in the possession of the Buffalo Bill Historical Center, Cody, Wyoming.

In identifying the bones, normal basic assumptions were made. Particularly to be noted here is that, unless evidence to the contrary can be found, the forms recovered are expected to be the same kinds now found in the area or species that now occur in nearby, different habitats but which could have lived at the site if different climatic-vegetational conditions had been present. Thus, in identifying the cottontails, for example, comparisons were made only with the three species whose present ranges approach the cave site, the numerous species occurring elsewhere being ignored.

In several cases, comparative materials for some of the possible species were unavailable, thus decreasing the reliability of identification (denoted by "cf." indicating close similarity and presumptive identity with the taxon cited, and "?" indicating an educated guess). The fragmentary nature of most elements also has resulted in uncertain or queried identifications.

The authority for present geographic ranges of the mammals is Long (1965), whose *The Mammals of Wyoming* provides an up-to-date source of distribution and taxonomy for the region. The scientific names used below also follow this work.

The minimum possible number of individuals of each kind present in each cultural level was calculated by observation of duplicated skeletal elements or obvious sexual or age differences. Bones only tentatively identified ("cf.") were included, but queried ("?") identifications were not.

### RESULTS

Identifications and minimum numbers of animals are given for the entire site in Table I; these are summarized by cultural level in Table II; and they are given in greater detail by level in Table III.

Of the 31 individual birds recorded, most (nine) are perching birds (Passeriformes), one of which is a Common Raven (*Corvus corax*). Thirteen birds, represented mostly by fragments, are unidentified to any lower taxonomic level, but many probably also are perching birds. The duck and goose (cf. *Branta canadensis*) represent a water habitat, whereas the grouse are most commonly forest dwellers. The great Horned Owl (*Bubo virginianus*) is found in a wide variety of habitats and sometimes utilizes caves for shelter.

The Water Shrew (*Sorex palustris*) is represented by a tibia. These shrews tend to be restricted to streamside habitats, though they have been collected in Montana where streams were small or temporarily dry (Kinsella 1967).

A bat humerus suggests the cave has been utilized as a roost upon occasion by at least one of the several species in the area. On the basis of size, likely one of the species of *Myotis* is involved.

Nuttall's Cottontail (*Sylvilagus nuttalli*) appears to be the only species of cottontail present about the cave now. The Eastern Cottontail (*S. floridanus*) occurs farther to the southeast, primarily in grassland habitats; the Desert Cottontail (*S. auduboni*) tends to frequent more open country and lower altitudes than does *S. nuttalli*, though they occur sympatrically in many areas. The only specifically identifiable cottontails from the cave are Nuttall's.

Three species of hare (*Lepus*) occur in the general region of concern. Two of these, the White-Tailed Jack Rabbit (*L. townsendi*) and the Snowshoe Rabbit (*L. americanus*), occur in the study area now; the third, the Black-Tailed Jack Rabbit (*L. californicus*), occurs only at lower elevations to the southwest and southeast. Both the White-Tailed Jack Rabbit and the Snowshoe Rabbit are identifiable from the skeletal remains; there is nothing to suggest presence of the Black-Tailed Jack Rabbit.

Three kinds of chipmunks (*Eutamias*) occur now in northwestern Wyoming. These are the Least Chipmunk (*E. minimus*), the Yellow-Pine Chipmunk (*E. amoenus*), and the Uinta Chipmunk (*E. umbrinus*). A fourth species, the Cliff Chipmunk (*E. dorsalis*), occurs in southwestern Wyoming. The specimen from Mummy Cave is not a Cliff Chipmunk, but which of the other three is represented cannot be determined at present.

The Yellow-Bellied Marmot (*Marmota flaviventris*) occurs throughout the higher portions of Wyoming. It is represented by at least nine individuals from the cave.

Parietals and dentaries of two ground squirrels in the general size range of Richardson's Ground Squirrel (*Spermophilus richardsoni*) and the Uintan Ground Squirrel (*S. armatus*) were recovered. On the basis of size, the latter likely is the species represented. The Uinta Ground Squirrel occurs near the cave now; Richardson's Ground Squirrel occurs farther to the south only.

Five, possibly six, Beavers (*Castor canadensis*) are represented. These rodents are rather closely tied to a stream or river habitat.

At present, the only White-Footed Mouse (*Peromyscus*) in northwestern Wyoming is the Deer Mouse (*P. maniculatus*). The recovered skeletal elements are not inconsistent with such an identification.

A similar situation occurs with the wood rats (*Neotoma*). The Bushy-Tailed Wood Rat (*N. cinerea*) is the only species recorded from Wyoming; some of the remains definitely are of this species and the remaining specimens do not point to the presence of other species.

At least two species of voles (*Microtus*) are represented in the recovered fauna. One surely is Richardson's Vole (*M. richardsoni*), no other vole in the area attaining such a large size. The Montane Vole (*M. montanus*) likely is represented also. The Meadow Vole (*M. pennsylvanicus*) and Long-Tailed Vole (*M. longicaudus*) also occur in the general region today, but the remaining individuals from the cave fill are identifiable only to the genus *Microtus*.

Porcupines (*Erethizon dorsatum*) are common — at least seven individuals — within the skeletal material as they are throughout most of Wyoming at present.

Canid remains are present in small numbers. The genus *Canis* (dog, coyote, wolf, etc.) definitely is represented, but remains are too fragmentary to determine surely which of the three dog-like forms, Gray Wolf (*C. lupus*), Coyote (*C. latrans*), and Dog (*C. familiaris*), are represented. Two size classes can be noted and most likely Coyote and Dog are present. The queried identification of Wolf or Dog from Culture Layer 18 is based upon a single incisor only.

Occurring only as badly preserved material is a smaller canid, probably the Red Fox (*Vulpes vulpes*), but the poor preservation prevents sure identification. Red Foxes do occur in northwestern Wyoming at present.

A bear canine tooth is probably from a Black Bear (*Ursus americanus*); the Grizzly Bear (*Ursus arctos*) is represented by two upper molar teeth. Both bears occur in the area now.

Although several mustelids live in northwestern Wyoming, only the Marten (*Martes americana*) is identified from the recovered bone material. It is represented by a lower jaw.

Both the Bobcat (*Lynx rufus*) and Lynx (*L. canadensis*) occur in the vicinity of the cave. A partial radius indicates presence of one or the other in the uppermost cultural level from which bone was recovered (Culture Layer 36).

Artiodactyls larger than deer are represented by portions of a skull and lower jaw; by a fragmentary condyle of a metapodial; by part of a burned first phalanx; and by the articular portion of a shoulder blade. The skull and jaw pieces probably are of Wapiti (*Cervus canadensis*), but comparative material of Moose (*Alces alces*) is not available for comparison. The condyle and first phalanx are of such size as possibly to pertain to either of these forms or to Bison (*Bison bison*). The shoulder blade is from a large Bison. All three forms occurred historically within the immediate region.

At least 15 deer (*Odocoileus*) were recovered. Only one specimen has been identified tentatively to species (i.e., to *O. virginianus*, the White-Tailed Deer), but likely both the White-Tailed Deer and the Mule Deer (*O. hemionus*) are represented.

The presence of tremendous numbers of Mountain Sheep (*Ovis canadensis*) is the dominant feature of the recovered fauna. At least 88 individuals are represented and, of the cultural levels that supplied bone, only Culture Layers 4 and 5 lack these animals.

## DISCUSSION

A perusal of the animals identified from Mummy Cave shows no form not now found in the area. Thus the recovered fauna does not indicate appreciable climatic-vegetational changes occurring at the cave site during the last 9000 or so years.

Several factors may conceal some climatic change, however. First, a small proportion of the recovered fauna is made up of the smaller, climate-sensitive species. Thus, fluctuations in abundance of these kinds — or alternations of presence and absence — cannot be clear-cut because of the small sample. Second, some climatic fluctuation could occur before many members adapted to the present environment would be forced out and replaced by other forms. The position of the cave well within a life-zone provides a buffering effect not present in areas near or in zones of tension among major plant associations.

Regardless of the actual presence or absence of climatic changes, the effects upon humans in the area likely would be few since there is no indication of significant changes in prey species of mammals or birds. The single exception is in numbers of Mountain Sheep — the high numbers from Cultural Levels 30 and 36 could conceivably be a result of climatic conditions, as noted below.

The most important species utilized by Man was the Mountain Sheep. Not only is it the commonest member of the recovered fauna, but many cuts on various bones and many burned elements definitely tie these animals to human use. There seems to have been no discrimination as to sex or age in the hunting of these sheep. Aged, mature, young, and even fetal or new-born animals are represented as are both sexes.

A common Southwestern archeological relationship between numbers of Mountain Sheep and deer is pretty much reversed here, with far greater numbers of sheep than deer being represented; about 88 sheep to 15 deer — an approximate ratio of 6:1. Judging from descriptions of the area, deer should be rather plentiful, likely commoner than sheep.

Although sheep numbers are consistently equal or greater than deer numbers throughout the cave fill, with the exception of Culture Layer 4, the imbalance is not great except for Culture Layers 30 and 36.

Several explanations are possible for the large number of sheep from these levels. Possibly the cave was used primarily as a base camp for hunts in the nearby, higher country, where fewer deer but more Mountain Sheep would be found. The larger total number of animals represented may indicate larger

hunting parties or longer occupancy than at other levels. The smaller game, possibly collected by women or youths from the vicinity of the cave, also is present in relatively great numbers.

Or, there may actually have been more sheep present around the cave at these times than during other periods. Mountain Sheep tend to descend to lower levels in winter than are occupied in summer, particularly during years of severe weather conditions. During hard winters, the cave area might be nearly abandoned by these animals, with the bulk of the sheep herds at lower elevations; under milder conditions, the region might support a heavy winter population. In the latter case, the animals would be particularly vulnerable to human predation. Thus Levels 30 and 36 conceivably could represent occupancy during winter hunts. Level 30 shows the presence of a migratory bird and several mammalian hibernators; likely it was inhabited during warmer weather whether or not it was used during the winter also. Level 36 does not show the presence of strictly warm weather forms.

That deer were used for food and tools is evidenced by butchering marks on several elements, burned fragments of limb bones, and a worked antler base. Among the other mammalian elements, a rabbit shoulder blade displays cut marks and a beaver humerus has been partially burned, indicating association with man. Likely many of the birds and some of the other mammals were utilized, but in the absence of definite evidence, their use can only be surmised. Marmots generally seem to prefer smaller crevices and self-made burrows to larger chambers, so it is quite likely that man is responsible for their presence in Mummy Cave. Likewise, the rabbits in general are forms likely to have been added to the cave fauna by man or other predators. It seems reasonable to list duck, goose, grouse, and marmot as forms probably used and the deer, mountain sheep, rabbits, and beaver as surely utilized. Wapiti and bison presumably were used also. The remaining birds, porcupine, chipmunk, ground squirrel, small rodents, and carnivores could well have been used or could just as well represent natural occurrences.

Dogs may have been present at the time of deposition of Culture Layer 17 and at least sporadically thereafter, but the remains are too equivocal for certainty.

The presence of a fetal or newborn artiodactyl (probably a mountain sheep) indicates occupation during early spring. Likely some of the younger mountain sheep were killed during their first summer. Several of the birds (e.g., goose) migrate from the area during the colder seasons and some of the mammals (marmot, chipmunk, and ground squirrels) hibernate, also indicating warm season occupancy if man is responsible for their presence. Bears, which have a torpid cold-weather period, are more easily taken in winter, but of course are available from spring to fall also. It is probable that winter use was not the rule, though Culture Layers 30 and 36 may possibly indicate winter occupancy for hunting big game.

In general summary, the bones recovered from most levels seem similar insofar as the small samples can reveal, indicating little climatic change and similar cultural use by the peoples involved. The local birds were utilized as were such medium-sized mammals as hares, cottontails, and marmots. Major dependency for meats was upon the mountain sheep, though cervids also were taken. Carnivores may have been killed for flesh or skins and dogs may have been present after deposition of Culture Layer 16. Occupancy likely was limited to the warmer seasons, but winter use cannot be ruled out entirely.

Two levels (30 and 36) do not fit this general description in that they show a much higher proportion of mountain sheep than do the other levels. The cave may have been used as a base camp for hunting mountain sheep in the nearby highlands, thus increasing the proportions of sheep to deer, which tend to occur in greatest numbers at lower altitudes. Another possibility is in winter occupancy during years when mountain sheep were forced down in large numbers to the vicinity of the cave by weather conditions.

### **Acknowledgements**

I wish to thank the University Research Institute for financial aid in acquiring modern comparative material. Particular thanks also are due Mr. Wilfred Husted, who has struggled through numerous questions and pleas for help during the identification period.

Table I. Mummy Cave tetrapods, with minimum possible numbers of each.

Bird .....	13	Wood Rat, <i>Neotoma</i> sp. ....	16
Duck .....	2	Bushy-Tailed Wood Rat, <i>Neotoma cinerea</i> .....	5
cf. Canada goose, cf. <i>Branta canadensis</i> .....	1	Vole, <i>Microtus</i> sp. ....	4
Fowl, Galliformes — probably Grouse .....	5	cf. Montane Vole, <i>Microtus</i> cf. <i>montanus</i> .....	2
Great Horned Owl, <i>Bubo virginianus</i> .....	1	Richardson's Vole, <i>Microtus richardsoni</i> .....	2
Perching Birds, Passeriformes .....	8	Porcupine, <i>Erethizon dorsatum</i> .....	7
Common Raven, <i>Corvus corax</i> .....	1	Carnivore .....	1
Water Shrew, <i>Sorex palustris</i> .....	1	cf. Canine, cf. <i>Canis</i> .....	1
cf. Mouse-Eared Bat, cf. <i>Myotis</i> .....	1	Dog or Coyote, <i>Canis familiaris</i> or <i>Canis latrans</i> .....	4
Cottontail, <i>Sylvilagus</i> sp. ....	6	cf. Dog or Wolf, cf. <i>Canis familiaris</i> or <i>Canis lupus</i> .....	1
Nuttall's Cottontail, <i>Sylvilagus nuttalli</i> .....	2	Red Fox (?), <i>Vulpes vulpes</i> (?) .....	2
Cottontail or Jack Rabbit, <i>Sylvilagus</i> or <i>Lepus</i> .....	1	Bear (?), <i>Ursus</i> (?) .....	2
Jack Rabbit, <i>Lepus</i> sp. ....	3	Bear, <i>Ursus</i> sp. ....	1
Snowshoe Rabbit, <i>Lepus americanus</i> .....	3	cf. Black Bear, <i>Ursus</i> cf. <i>americanus</i> .....	1
White-Tailed Jack Rabbit, <i>Lepus townsendi</i> .....	5	Grizzly Bear, <i>Ursus arctos</i> .....	1
Chipmunk, <i>Eutamias</i> sp. ....	1	Mustelid (?) .....	2
Yellow-Bellied Marmot (?), <i>Marmota flaviventris</i> (?) ...	1	Marten, <i>Martes americana</i> .....	1
Yellow-Bellied Marmot, <i>Marmota flaviventris</i> .....	9	Bobcat or Lynx, <i>Lynx</i> sp. ....	1
cf. Uinta Ground Squirrel, <i>Spermophilus</i> cf. <i>armatus</i> ...	2	Cervid .....	1
Beaver (?), <i>Castor canadensis</i> (?) .....	1	Wapiti or Moose, <i>Cervus</i> or <i>Alces</i> .....	1
Beaver, <i>Castor canadensis</i> .....	5	Wapiti, Moose, or Bison; <i>Cervus</i> , <i>Alces</i> , or <i>Bison</i> .....	1
Small Cricetid Rodent .....	1	Deer, <i>Odocoileus</i> sp. ....	14
cf. White-Footed Mouse, cf. <i>Peromyscus</i> .....	1	cf. White-Tailed Deer, <i>Odocoileus</i> cf. <i>virginianus</i> .....	1
cf. Deer Mouse, <i>Peromyscus</i> cf. <i>maniculatus</i> .....	4	Bison, <i>Bison bison</i> .....	1
Wood Rat (?), <i>Neotoma</i> (?) .....	1	Mountain Sheep, <i>Ovis canadensis</i> .....	88

Table II. Summary of tetrapod distribution by level.

	Level	1	4	5	6	8	9	10	11	12	14	15	16	17	18	19	20	21	23	24	26	27	28	30	32	34	36
Bird	-	-	-	1	-	1	-	-	-	-	2	-	1	-	1	-	1	1	-	-	-	1	1	2	1	-	
Duck	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
Goose	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Grouse	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	-	-	-	-	1	-	-	-	1	-	-	1
Owl	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Perching Bird	2	-	-	-	-	-	-	-	-	1	-	2	-	1	-	-	-	1	-	-	-	-	-	1	-	-	-
Raven	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Shrew	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-
Bat	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-
Cottontail	1	-	-	1	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	1	-	-	1	-	1	1	1
Jack Rabbit	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	1	-	-	-	-	-	1	-	-	-	-
Snowshoe Rabbit	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-
White-Tailed Jack Rabbit	1	1	-	-	-	-	-	-	-	-	-	-	-	1	1	-	-	-	-	1	-	-	-	-	-	-	-
Chipmunk	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Marmot	1	1	-	-	-	-	-	?	-	1	-	-	-	-	-	-	-	-	1	1	-	-	1	2	1	-	-
Ground Squirrel	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2	-	-	-
Beaver	-	?	-	-	-	-	-	-	-	-	-	-	1	-	-	-	1	-	-	-	-	-	-	1	-	-	2
Deer Mouse	1	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	1	-	-	-	-	-	-	-	-
Wood Rat	2	1	1	2	-	-	1	-	1	?	1	1	1	-	2	1	1	1	-	-	-	-	1	2	-	1	1
Vole	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Montane Vole	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	1	-
Richardson's Vole	2	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Porcupine	-	-	-	1	1	-	1	-	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	1	1
Dog or Coyote	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	1	-	-	-	-	-	1	-	-	-	-
Dog or Wolf	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Red Fox (?)	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	2
Bear	-	-	-	-	-	?	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	2
Marten	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-	-	-	-	-	-	-	-	-	-
Bobcat or Lynx	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Wapiti or Moose	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1
Wapiti, Moose, or Bison	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1	-	-	-
Deer	-	1	-	1	1	-	-	-	-	-	-	1	1	1	1	-	-	-	-	1	-	-	1	2	2	1	2
Mountain Sheep	1	-	-	1	2	4	4	4	3	2	1	1	2	2	4	1	1	1	1	3	1	1	5	17	2	2	25
	Level	1	4	5	6	8	9	10	11	12	14	15	16	17	18	19	20	21	23	24	26	27	28	30	32	34	36

Table III. Kinds of tetrapods and minimum numbers of each identified by level.

Level 1	Level 8	Level 15
Duck .....1	<i>Erethizon dorsatum</i> .....1	Bird ..... 2
Passeriform Bird .....2	<i>Ursus</i> (?) .....1	<i>Eutamias</i> sp., not <i>E. dorsalis</i> ..... 1
<i>Sylvilagus</i> sp. ....1	<i>Odocoileus</i> sp. ....1	<i>Peromyscus</i> cf. <i>maniculatus</i> ..... 1
<i>Lepus americanus</i> .....1	<i>Ovis canadensis</i> .....2	<i>Neotoma</i> sp. .... 1
<i>Lepus townsendi</i> .....1		<i>Microtus</i> sp. .... 1
<i>Marmota flaviventris</i> .....1	<b>Level 9</b>	cf. <i>Ovis canadensis</i> ..... 1
<i>Peromyscus</i> cf. <i>maniculatus</i> .....1	Bird .....1	<b>Level 16</b>
<i>Neotoma</i> sp. .... 1	<i>Neotoma</i> sp. .... 1	cf. <i>Branta canadensis</i> ..... 1
<i>Neotoma</i> cf. <i>cinerea</i> .....1	<i>Ovis canadensis</i> .....4	Galliform Bird, probably Grouse..... 1
<i>Microtus</i> sp. ....2		Passeriform Bird ..... 2
<i>Microtus richardsoni</i> .....2	<b>Level 10</b>	cf. <i>Castor canadensis</i> ..... 1
<i>Vulpes vulpes</i> (?) .....1	<i>Corvus corax</i> .....1	Small Cricetid Rodent ..... 1
Mustelid (?) .....1	<i>Neotoma</i> sp. .... 1	<i>Neotoma</i> sp. .... 1
<i>Ovis canadensis</i> .....1	<i>Marmota</i> (?) .....1	<i>Odocoileus</i> sp. .... 1
	<i>Erethizon dorsatum</i> .....1	<i>Ovis canadensis</i> ..... 2
<b>Level 4</b>	<i>Ovis canadensis</i> .....4	
<i>Lepus townsendi</i> .....1		<b>Level 17</b>
<i>Castor canadensis</i> (?).....1	<b>Level 11</b>	Bird ..... 1
<i>Marmota flaviventris</i> .....1	Cervid .....1	<i>Sylvilagus</i> sp. .... 1
<i>Neotoma</i> sp. .... 1	<i>Ovis canadensis</i> .....3	<i>Lepus townsendi</i> ..... 1
<i>Odocoileus</i> sp. ....1		<i>Microtus</i> cf. <i>montanus</i> ..... 1
	<b>Level 12</b>	<i>Canis familiaris</i> or <i>C. latrans</i> ..... 1
<b>Level 5</b>	<i>Marmota flaviventris</i> .....1	<i>Odocoileus</i> sp. .... 1
<i>Neotoma</i> sp. .... 1	<i>Neotoma</i> sp. .... 1	<i>Ovis canadensis</i> ..... 2
	<i>Erethizon dorsatum</i> .....1	
<b>Level 6</b>	<i>Ovis canadensis</i> .....2	<b>Level 18</b>
Bird .....1		Galliform Bird, probably Grouse..... 1
<i>Sylvilagus nuttalli</i> .....1	<b>Level 14</b>	Passeriform Bird ..... 1
<i>Lepus americanus</i> .....1	Passeriform Bird .....1	<i>Lepus townsendi</i> ..... 1
<i>Neotoma</i> sp. ....2	cf. <i>Lepus</i> .....1	<i>Peromyscus</i> cf. <i>maniculatus</i> ..... 2
<i>Erethizon dorsatum</i> .....1	<i>Neotoma</i> (?) .....1	<i>Neotoma</i> sp. .... 2
<i>Odocoileus</i> sp. ....1	<i>Ovis canadensis</i> .....1	cf. <i>Canis familiaris</i> or <i>C. lupus</i> ..... 1
cf. <i>Ovis canadensis</i> .....1		<i>Martes americana</i> ..... 1
		<i>Odocoileus</i> sp. .... 1
		<i>Ovis canadensis</i> ..... 4



**Level 19**

Bird .....	1
cf. <i>Peromyscus</i> .....	1
<i>Neotoma</i> sp. ....	1
<i>Ovis canadensis</i> .....	1

**Level 20**

<i>Sorex palustris</i> .....	1
<i>Lepus</i> sp. ....	1
<i>Castor canadensis</i> .....	1
<i>Neotoma</i> sp. ....	1
Carnivore .....	1
<i>Canis latrans</i> or <i>C. familiaris</i> .....	1
<i>Ovis canadensis</i> .....	1

**Level 21**

Bird .....	1
<i>Neotoma</i> sp. ....	1
<i>Ovis canadensis</i> .....	1

**Level 23**

Bird .....	1
Passeriform Bird .....	1
<i>Marmota flaviventris</i> .....	1
<i>Peromyscus</i> cf. <i>maniculatus</i> .....	1
<i>Microtus</i> sp. ....	1
cf. <i>Ovis canadensis</i> .....	1

**Level 24**

Galliform Bird, probably Grouse .....	1
<i>Sylvilagus</i> sp. ....	1
<i>Lepus townsendi</i> .....	1
cf. <i>Marmota flaviventris</i> .....	1
<i>Odocoileus</i> sp. ....	1
<i>Ovis canadensis</i> .....	3

**Level 26**

<i>Ovis canadensis</i> .....	1
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**Level 27**

<i>Ovis canadensis</i> .....	1
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**Level 28**

Bird .....	1
cf. <i>Myotis</i> .....	1
<i>Sylvilagus</i> sp. ....	1
<i>Lepus</i> sp. ....	1
cf. <i>Marmota flaviventris</i> .....	1
<i>Neotoma</i> sp. ....	1
<i>Canis latrans</i> or <i>C. familiaris</i> .....	1
cf. <i>Odocoileus</i> .....	1
<i>Ovis canadensis</i> .....	5

**Level 30**

Bird .....	1
Duck, small .....	1
Galliform Bird, probably Grouse .....	1
Passeriform Bird .....	1
<i>Sylvilagus</i> or <i>Lepus</i> .....	1
<i>Castor canadensis</i> .....	1
<i>Marmota flaviventris</i> .....	2
<i>Spermophilus</i> cf. <i>armatus</i> .....	2
<i>Neotoma</i> cf. <i>cinerea</i> .....	2
<i>Erethizon dorsatum</i> .....	1
cf. <i>Canis</i> .....	1
<i>Vulpes vulpes</i> (?) .....	1
<i>Ursus</i> sp. ....	1
Mustelid (?) .....	1
<i>Odocoileus</i> sp. ....	1
<i>Odocoileus</i> cf. <i>virginianus</i> .....	1
<i>Cervus</i> , <i>Alces</i> , or <i>Bison</i> .....	1
<i>Ovis canadensis</i> .....	17

**Level 32**

Bird .....	2
<i>Sylvilagus</i> sp. ....	1
<i>Lepus</i> cf. <i>americanus</i> .....	1
cf. <i>Marmota flaviventris</i> .....	1
<i>Odocoileus</i> sp. ....	2
<i>Ovis canadensis</i> .....	2

**Level 32–34**

<i>Sylvilagus nuttalli</i> .....	1
<i>Ovis canadensis</i> .....	1

**Level 34**

Bird .....	1
<i>Sylvilagus</i> sp. ....	1
<i>Neotoma cinerea</i> .....	1
<i>Microtus</i> cf. <i>montanus</i> .....	1
<i>Erethizon dorsatum</i> .....	1
<i>Odocoileus</i> sp. ....	1
<i>Ovis canadensis</i> .....	2

**Level 36**

Galliform Bird, probably Grouse.....	1
<i>Bubo virginianus</i> .....	1
<i>Sylvilagus</i> sp. ....	1
<i>Castor canadensis</i> .....	2
<i>Neotoma</i> cf. <i>cinerea</i> .....	1
<i>Erethizon dorsatum</i> .....	1
<i>Canis familiaris</i> or <i>C. latrans</i> .....	1
<i>Ursus</i> cf. <i>americanus</i> .....	1
<i>Ursus arctos</i> .....	1
<i>Lynx</i> sp. ....	1
cf. <i>Cervus canadensis</i> , possibly <i>Alces</i> ..	1
<i>Odocoileus</i> sp. ....	2
<i>Ovis canadensis</i> .....	25

From the mouth of the cave, 35 feet below the surface, no level:

<i>Bison</i> cf. <i>bison</i> .....	1
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Plate 1a. Mummy Cave viewed from the west. North Fork, Shoshone River in foreground. Note highway below shelter.



Plate 1b. Uncontrolled excavations viewed from slope at south end of shelter. Note people at left center.

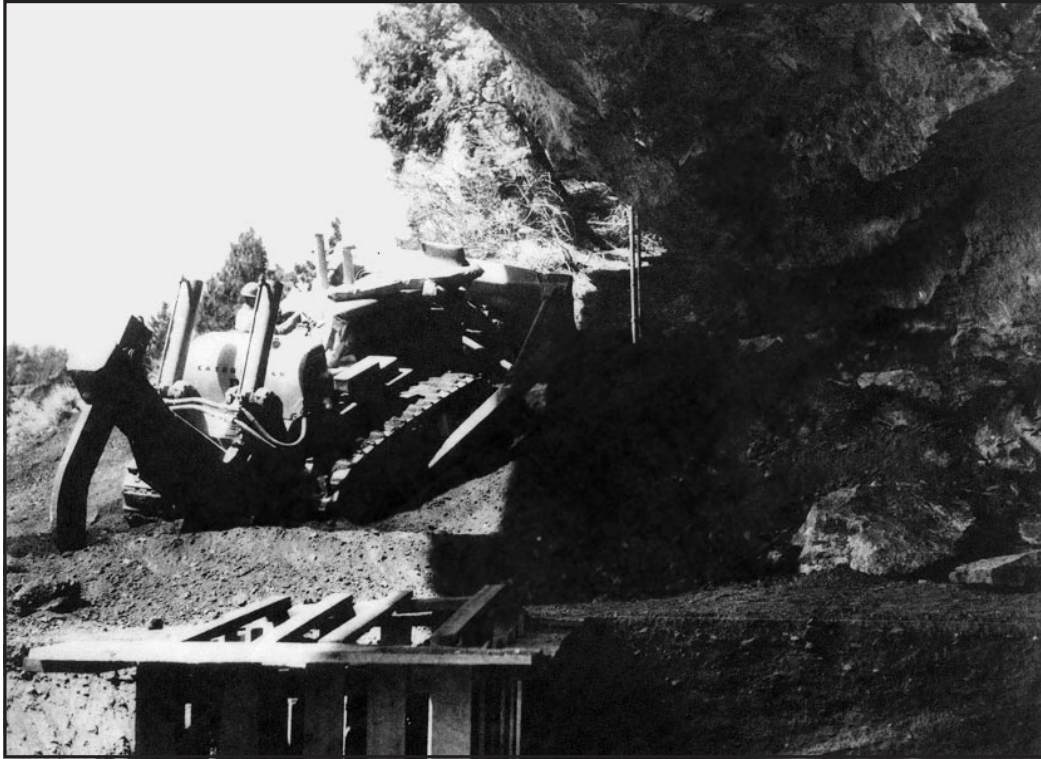


Plate 2a. Bulldozer cutting away talus slope at north end of site. Note top of wood shoring in deep test pit.



Plate 2b. Mummy Cave after completion of earth moving. Note fill deposited along highway in foreground and cones of backdirt behind vehicle.

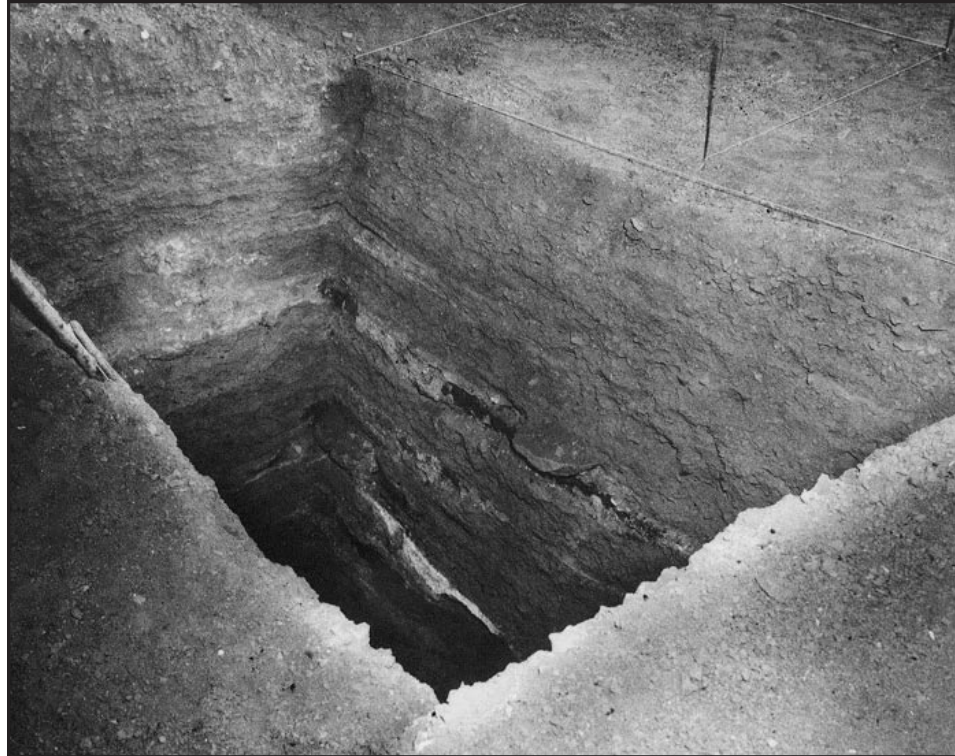


Plate 3a. View of stratigraphy below Layer 23 looking southwest. Note white ash of Culture Layer 14 in lower center.



Plate 3b. View of stratigraphy including Layers 22 through 8 looking northeast. Note dark layers of damp silt in lower center.

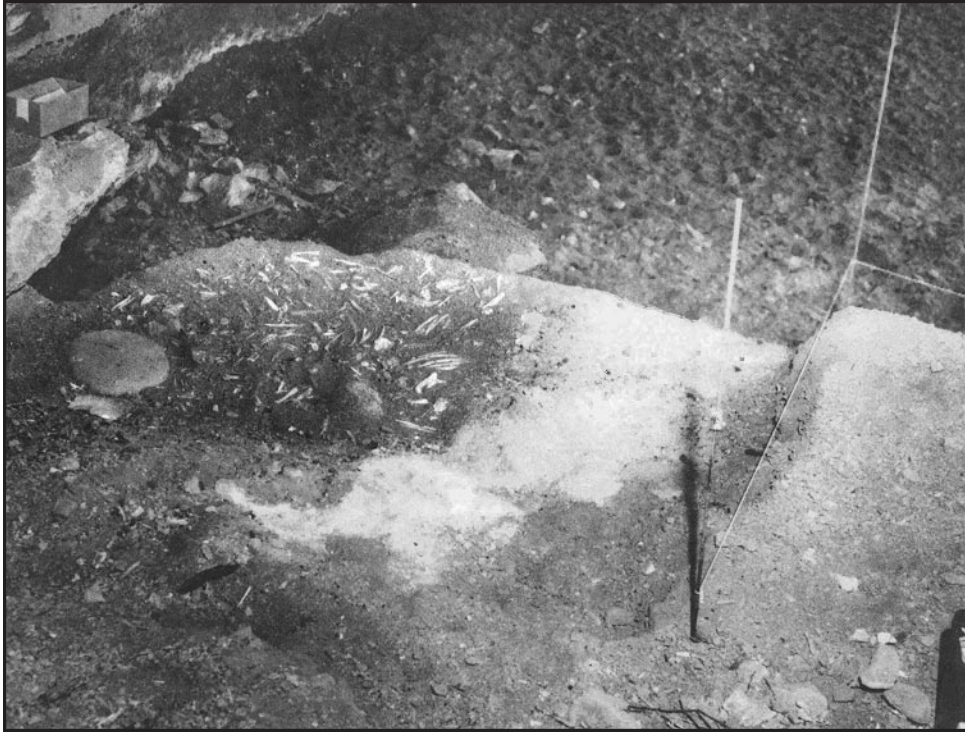


Plate 4a. Surface of Layer 36 looking southeast. Note bone fragments and anvil stone in left center.



Plate 4b. Alignment of rock slabs in Layer 10 looking southwest. Note fire pits associated with lower levels in foreground.



Plate 5a. Human burial soon after discovery viewed from the south. Note foot to right of trowel and hide robe at lower right.



Plate 5b. Burial after removal to the laboratory and restoration. Note fur and feather ornament over left ear.



Plate 6. Head of burial after removal from site. Note ornament over left ear and robe at lower right.

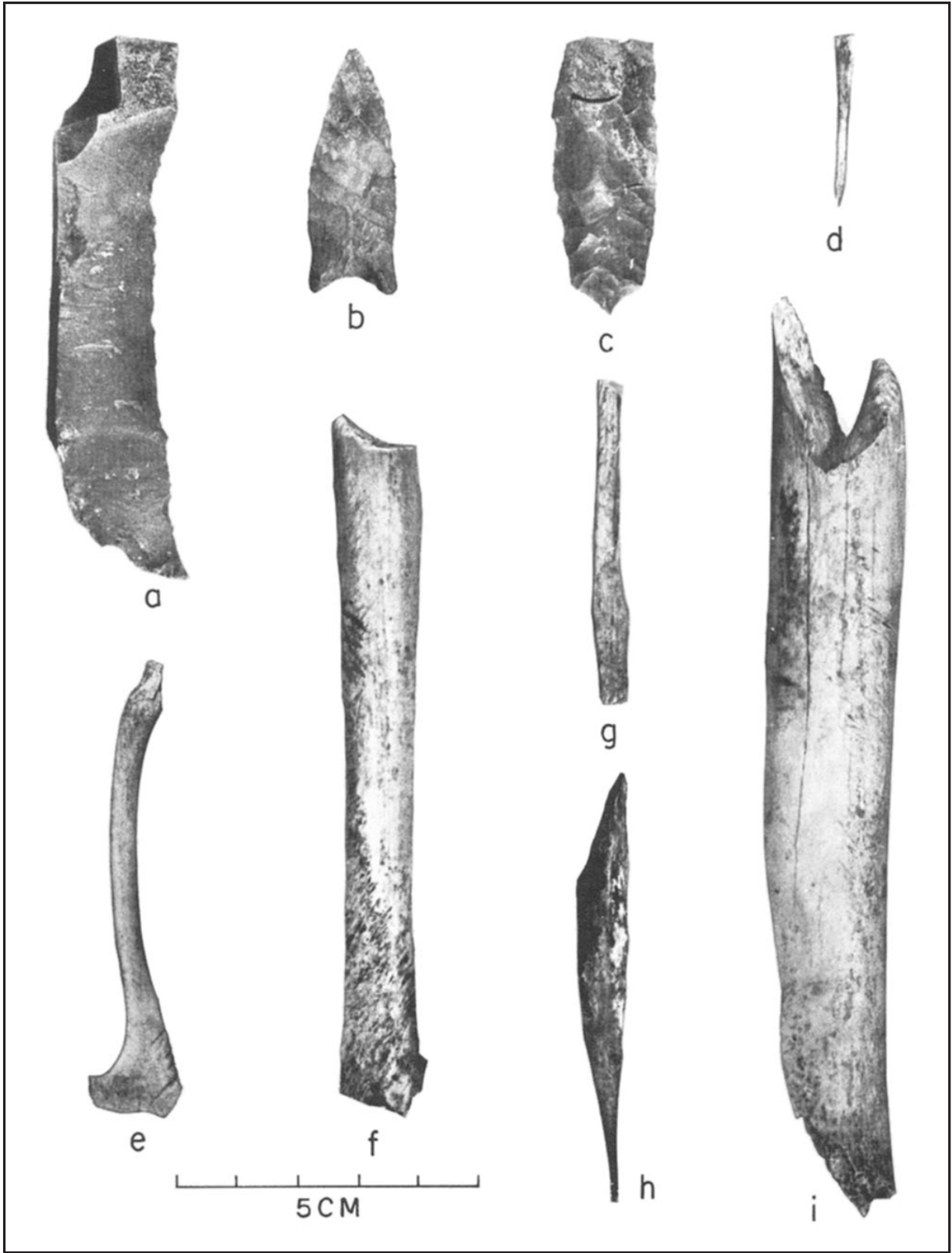


Plate 7. Chipped stone and bone : (a) blade, Layer 1; (b) projectile point, Layer 4; (c) graver, Layer 6; (d) rodent tibia awl, Layer 6; (e) incised bone, Layer 4; (f) flaker, Layer 6; (g-h) splinter awls, Layer 6; (i) cut bone, Layer 7.



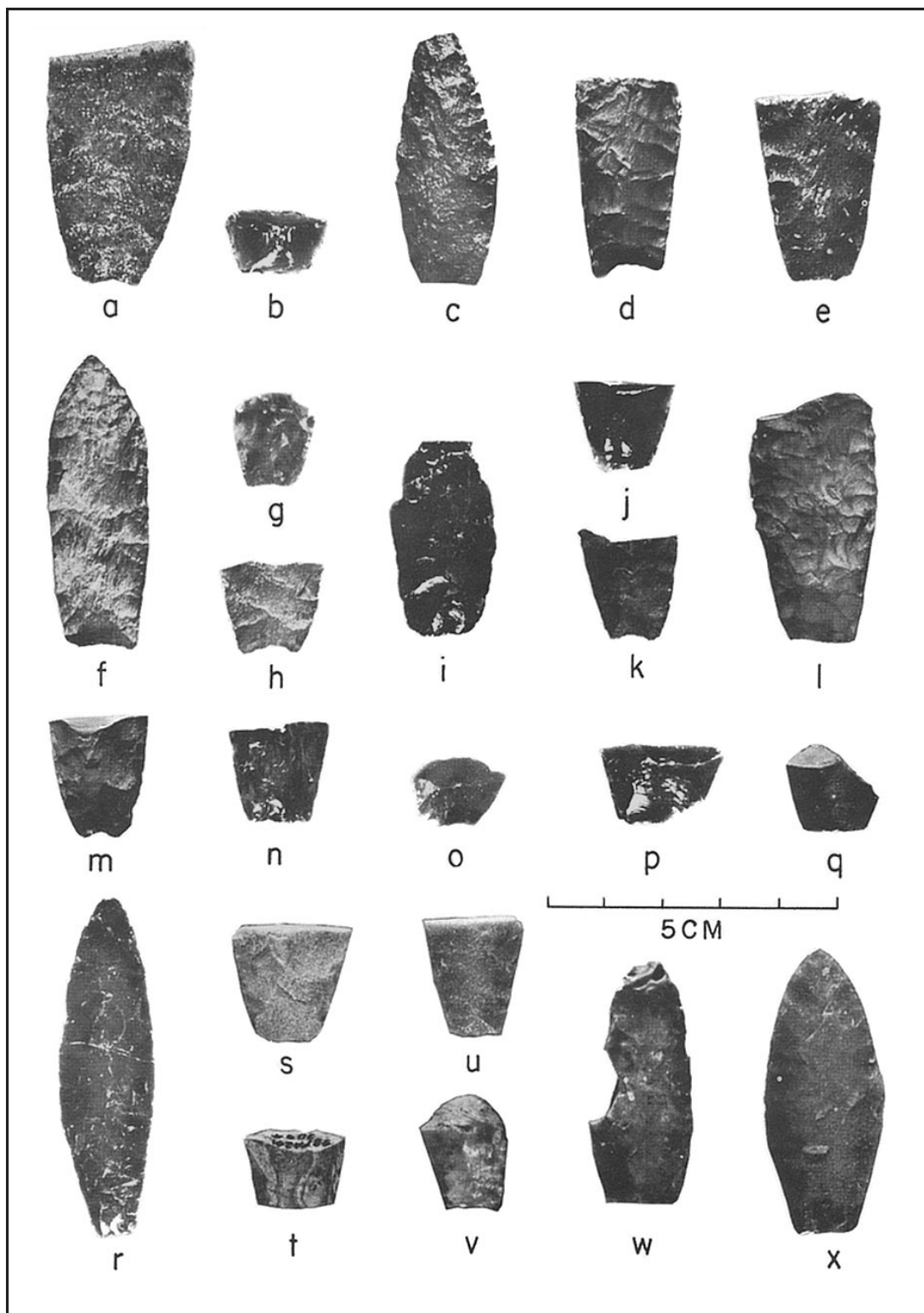


Plate 8. Lanceolate projectile points: (a) narrow concave base, Layer 12; (b) narrow straight base, Layer 12; (c) flat base, Layer 11; (d-h, m) narrow concave base, Layer 10; (i) convex base, Layer 10; (j-l) narrow concave base, Layer 9; (n) flat base, Layer 9; (o,q-s,u,x) narrow straight base, Layer 8; (p) narrow concave base, Layer 8; (t) narrow straight base, no provenience; (v) narrow concave base, no provenience; (w) flat base, Layer 8.

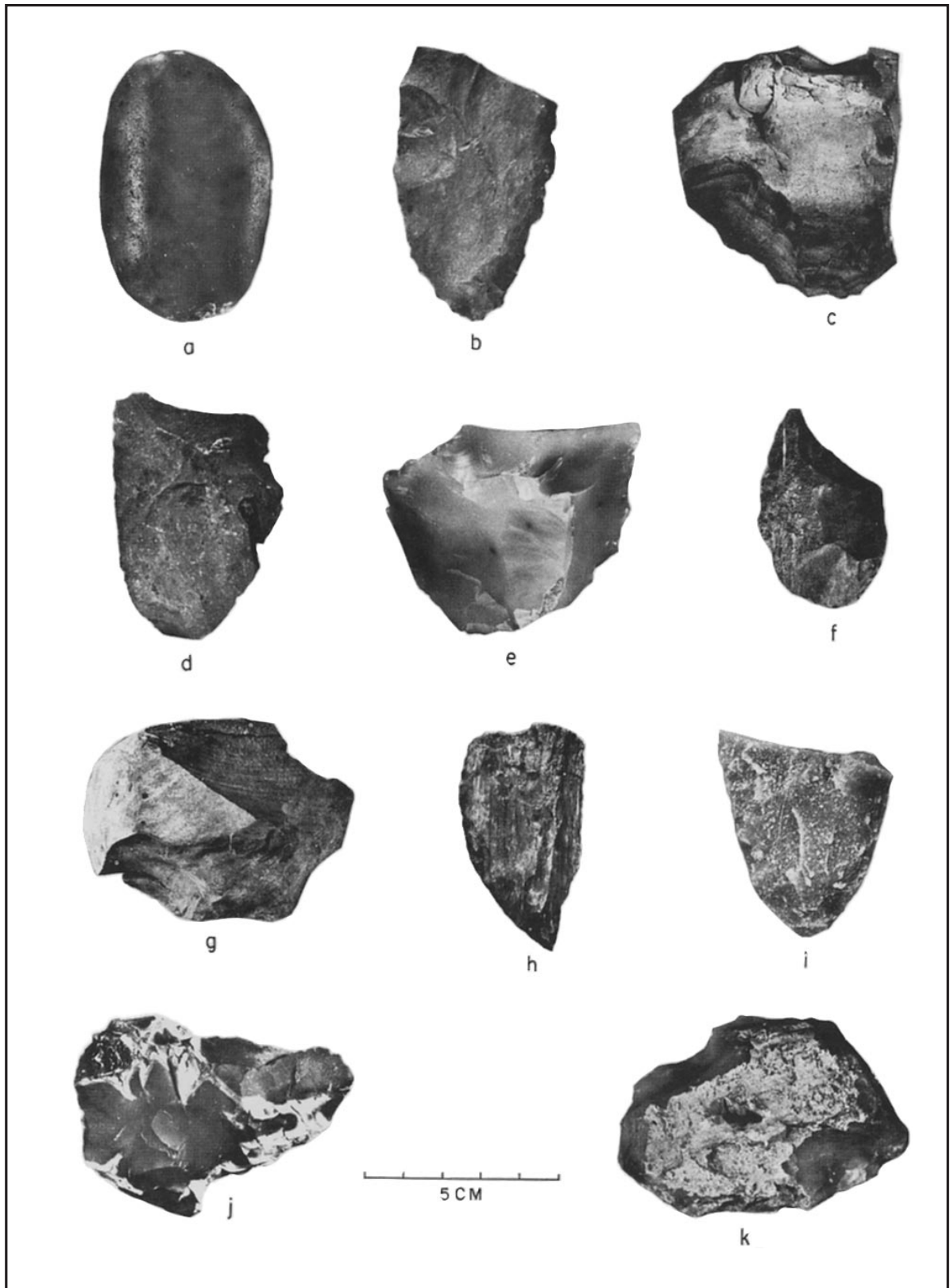


Plate 9. Pecked and chipped stone: (a) hammerstone, Layer 12; (b) knife, Layer 12; (c) chopper, Layer 11; (e) utilized core, Layer 12; (f) utilized flake, Layer 9; (g) chopper, Layer 10; (h) side scraper, Layer 10; (i) knife, Layer 10; (j) crude scraper, Layer 8; (k) small chopper, Layer 8.

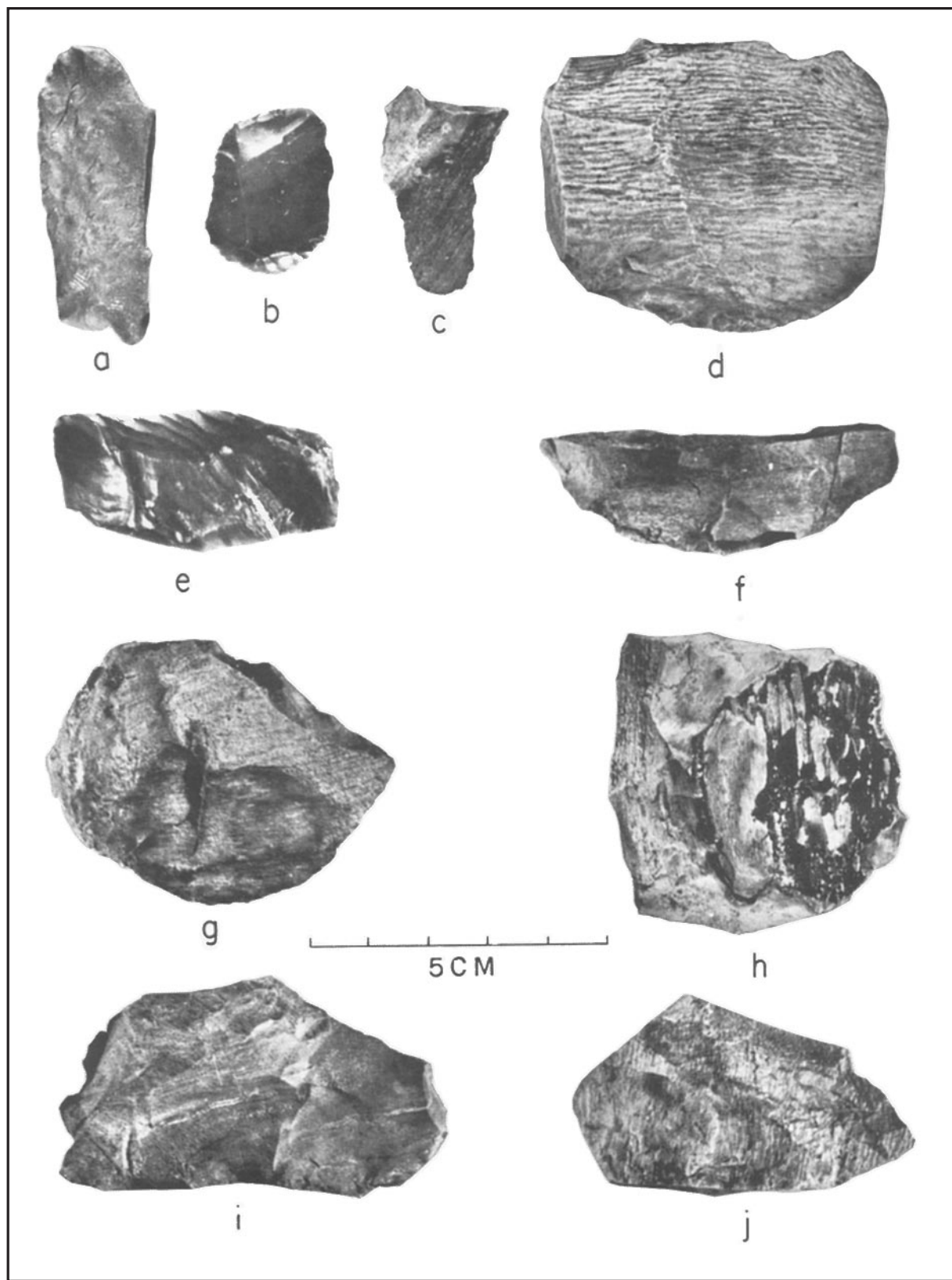


Plate 10. Chipped stone: (a) Lovell Constricted point, Layer 14; (b) ovate end scraper, Layer 14; (c) modified flake, Layer 14; (d) knife chopper, Layer 14; (e) flake scraper, Layer 14; (f,g) choppers, Layer 14; (h) rectangular end scraper, Layer 14; (i) chopper scraper, Layer 15; (j) graver, Layer 14.

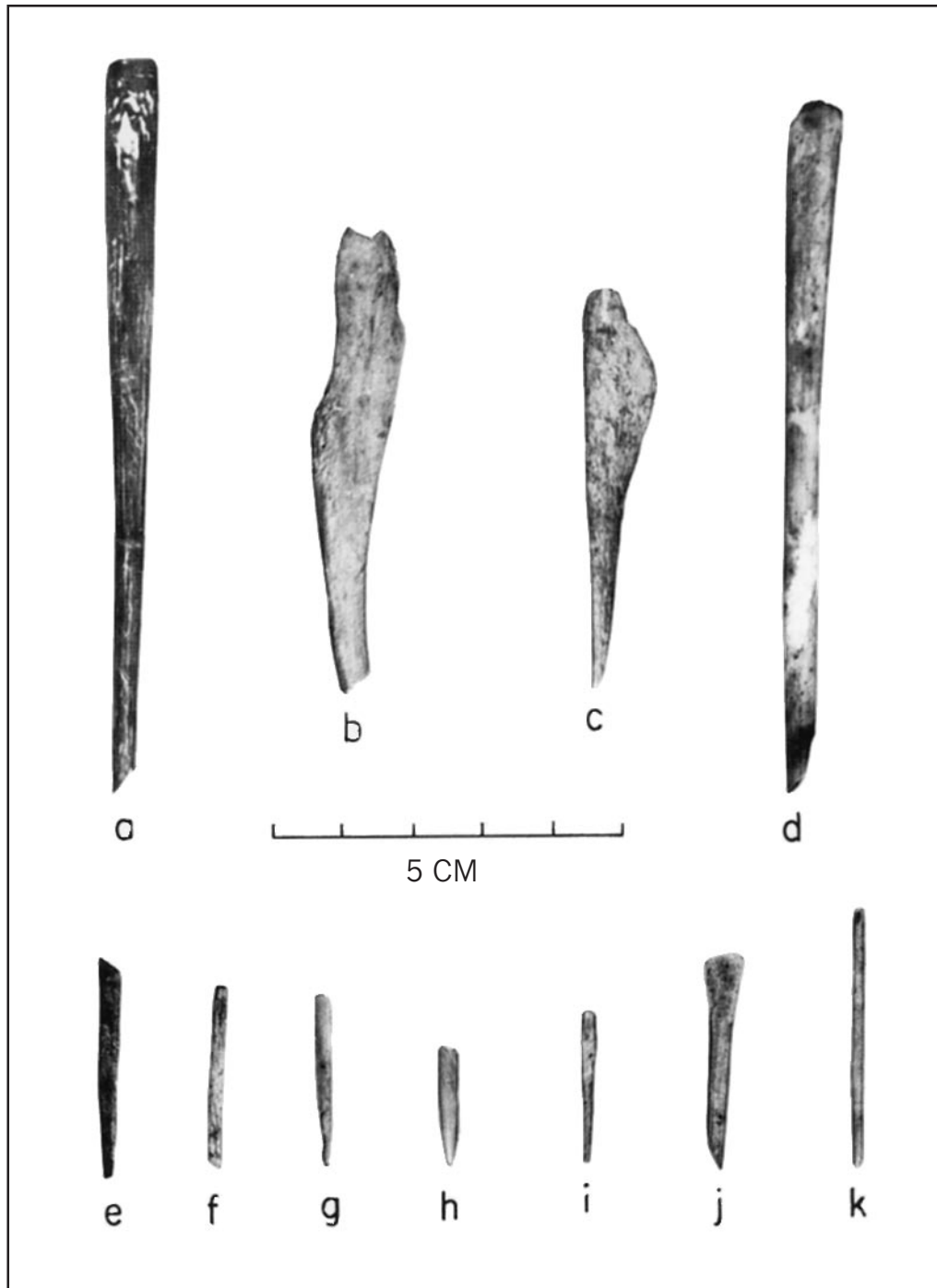


Plate 11. Bone: (a) polished awl, Layer 9; (b) cut bone, Layer 8; (c) splinter awl, Layer 9; (d) polished awl, Layer 8; (e,g) awl or needle tip, Layer 11; (f) needle, Layer 11; (h) awl tip, Layer 9; (i) awl midsection, Layer 8; (j) awl base, Layer 10; (k) needle, Layer 10.

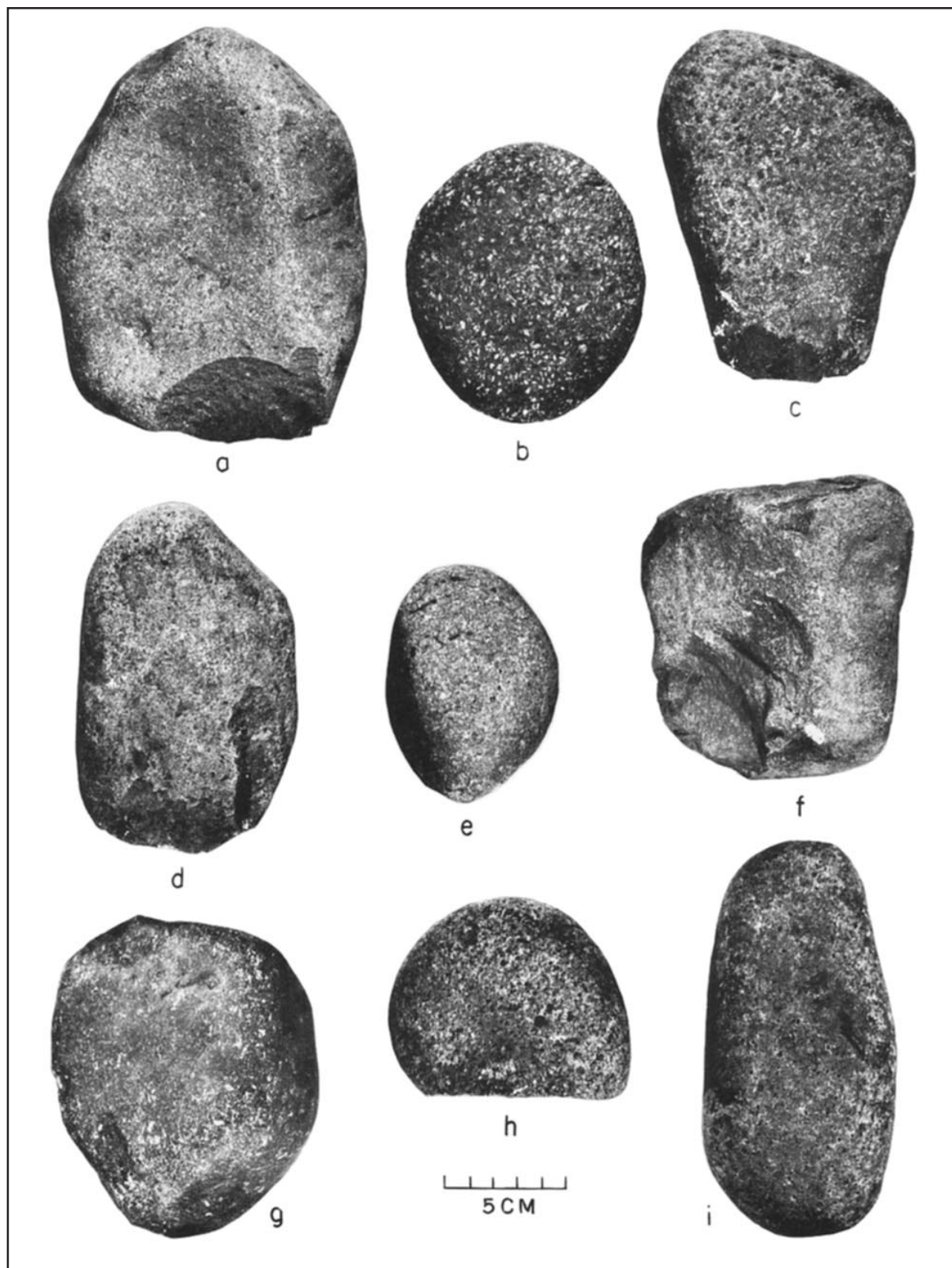


Plate 12. Rough stone: (a) cobble chopper, Layer 12; (b) hammerstone, Layer 12; (c,d) cobble choppers, Layer 11; (e) hammerstone, Layer 10; (f) cobble chopper, Layer 10; (g) cobble chopper, Layer 8; (h) cobble sharpening stone, Layer 8; (i) hammerstone, Layer 8.

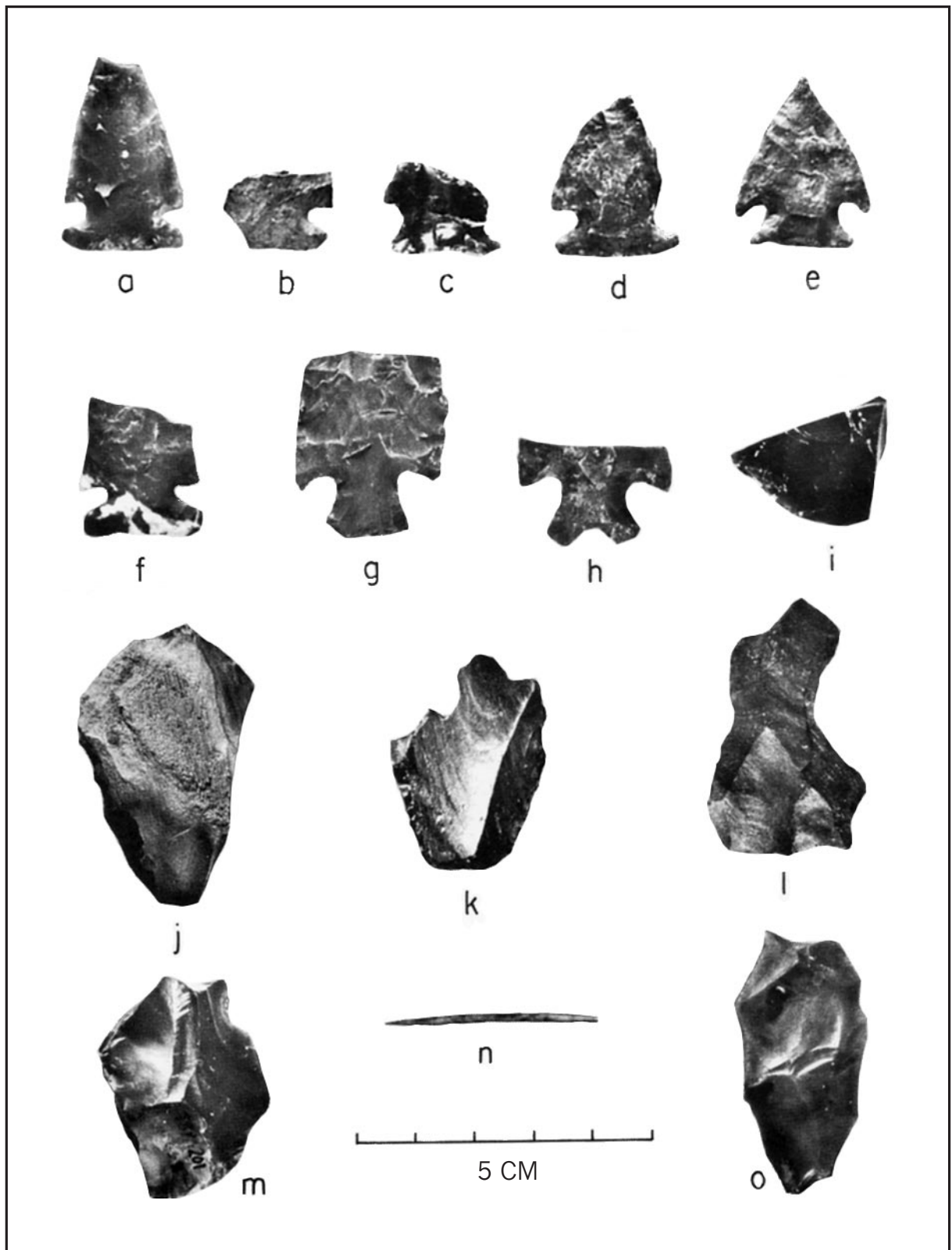


Plate 13. Chipped stone and bone, Layer 16: (a–d) Blackwater Side-Notched points; (e) corner-notched, sharp barbs point; (f) Pahaska Side-Notched point; (g) expanding stem sharp shoulders point; (h) expanding stem, sharp shoulders, indented base point; (i) knife; (j) side scraper; (k) end scraper; (l, m) modified flakes; (n) needle; (o) graver.

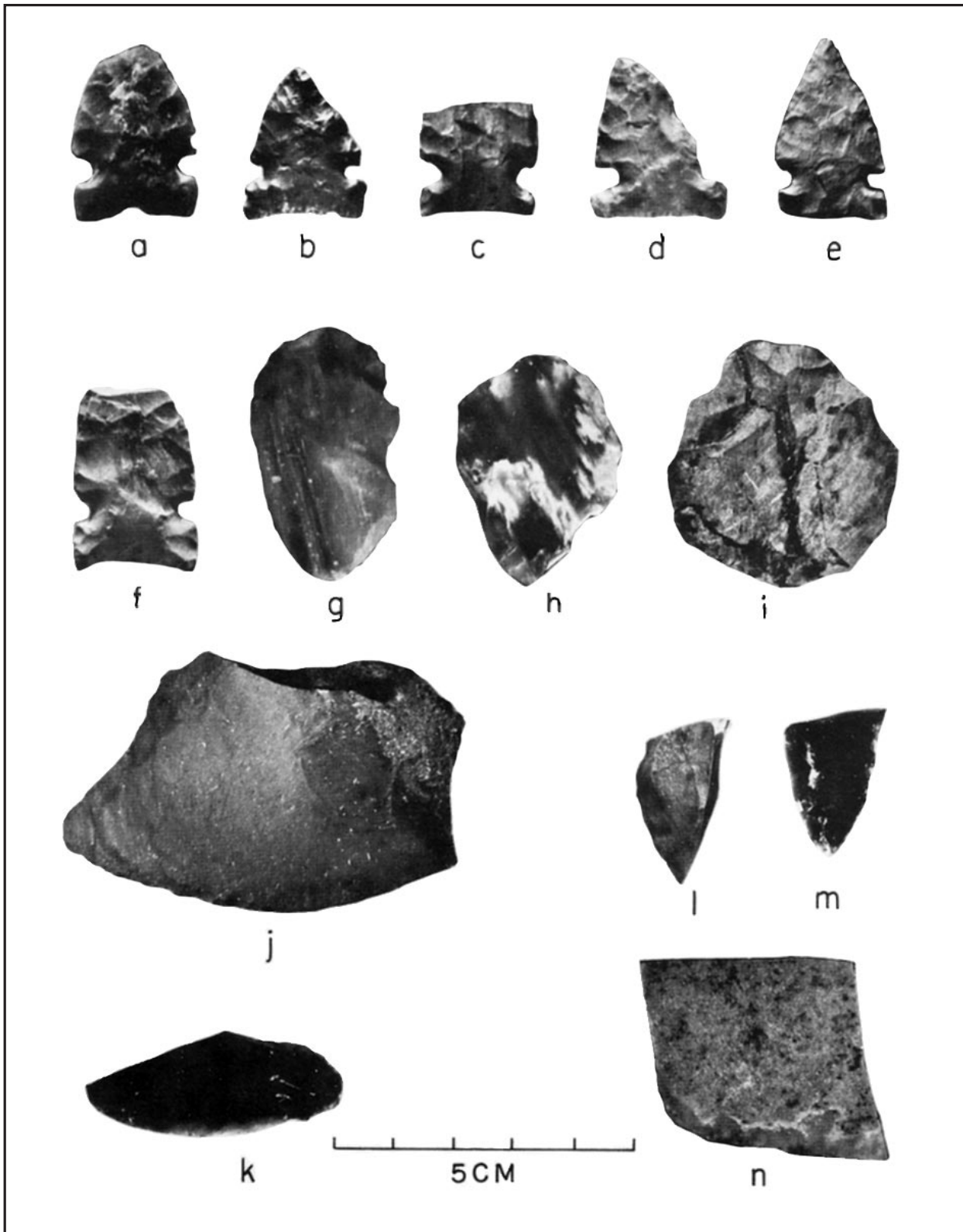


Plate 14. Chipped stone, Layer 17; (a–f) Pahaska Side-Notched points; (g) side scraper; (h) crude ovate knife; (i) ovate biface; (j,k) modified flakes; (l) side scraper; (m) graver; (n) plate chalcedony knife.

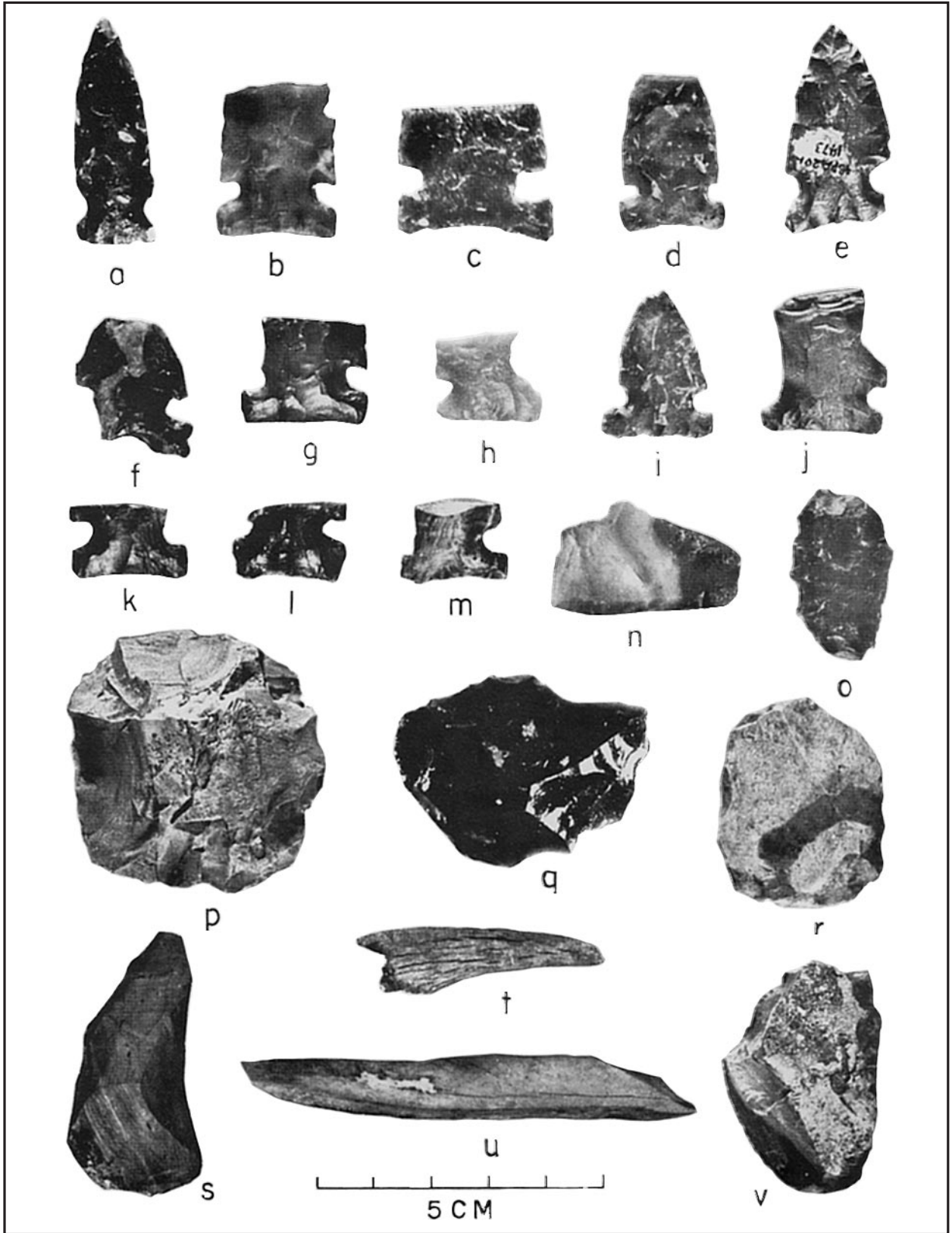


Plate 15. Chipped stone and bone, Layer 18: (a–m) Pahaska Side-Notched points; (n) modified flake; (o) serrate scraper (?); (p) biface; (q) knife; (r) crude end scraper; (s) flake scraper; (t) flaker tip; (u) splinter flaker (?); (v) crude end scraper.



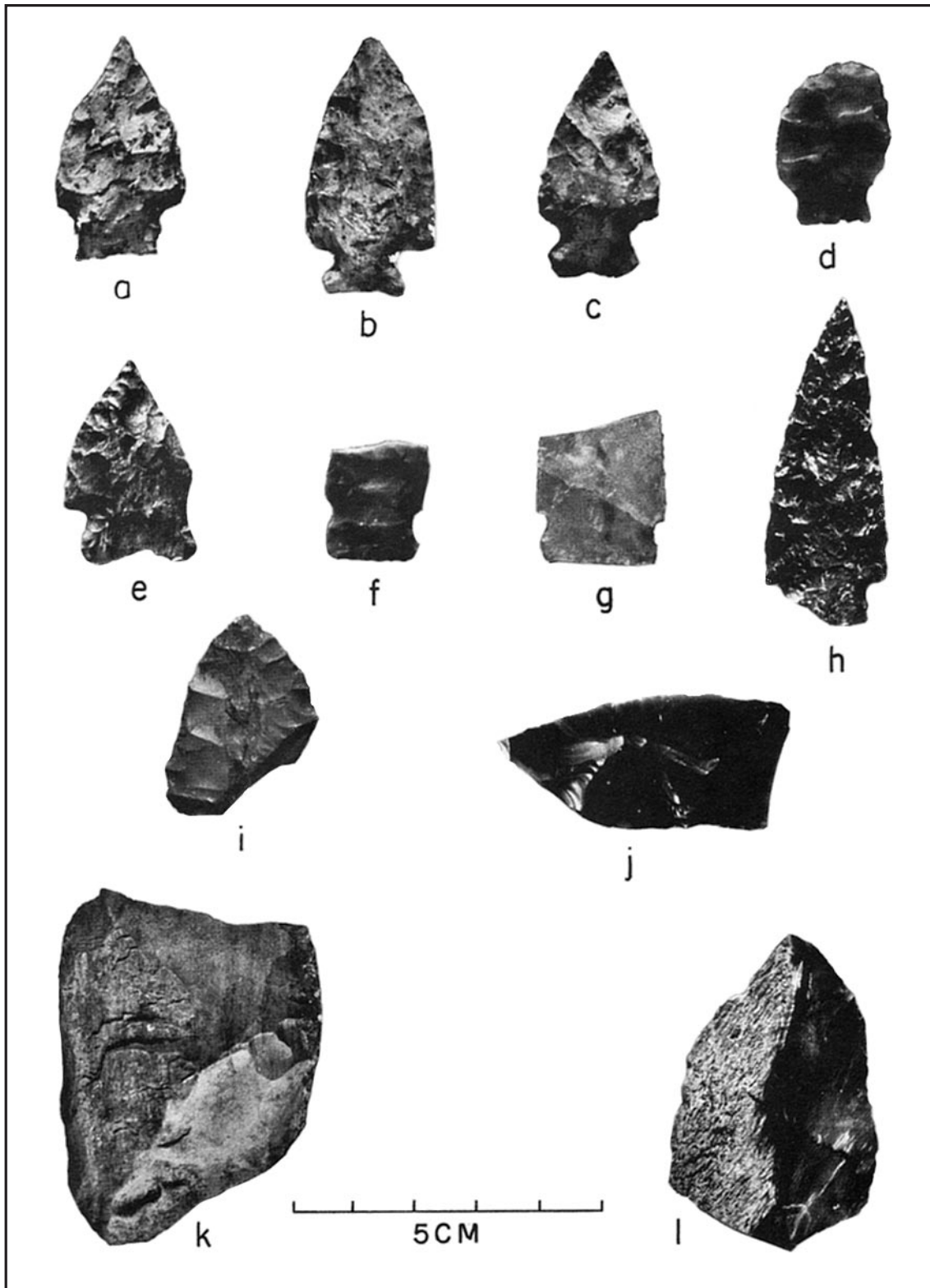


Plate 16. Chipped stone, Layer 24: (a–e) stemmed, straight to concave base points; (f,g) shallow side-notched, straight base points; (h) miscellaneous point; (i) small triangular knife; (j) modified flake; (k) side scraper; (l) utilized flake.

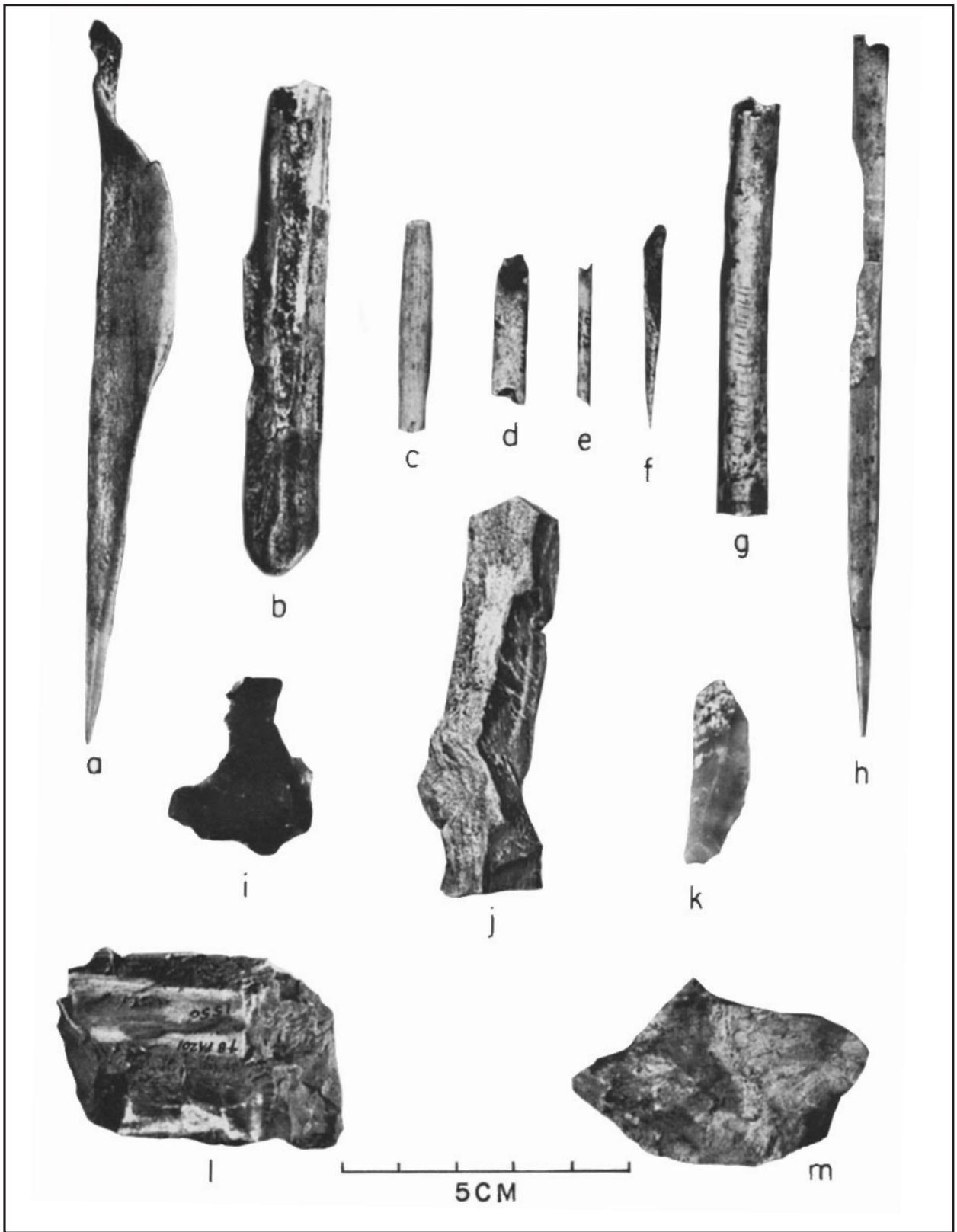


Plate 17. Chipped stone and bone, Layer 24: (a) metatarsal awl; (b) flaker; (c) mammal rib bead; (d,e) tubular beads; (f) splinter awl; (g) tube; (h) eyed awl; (i) flake scraper; (j,k) blades; (l,m) modified flakes.

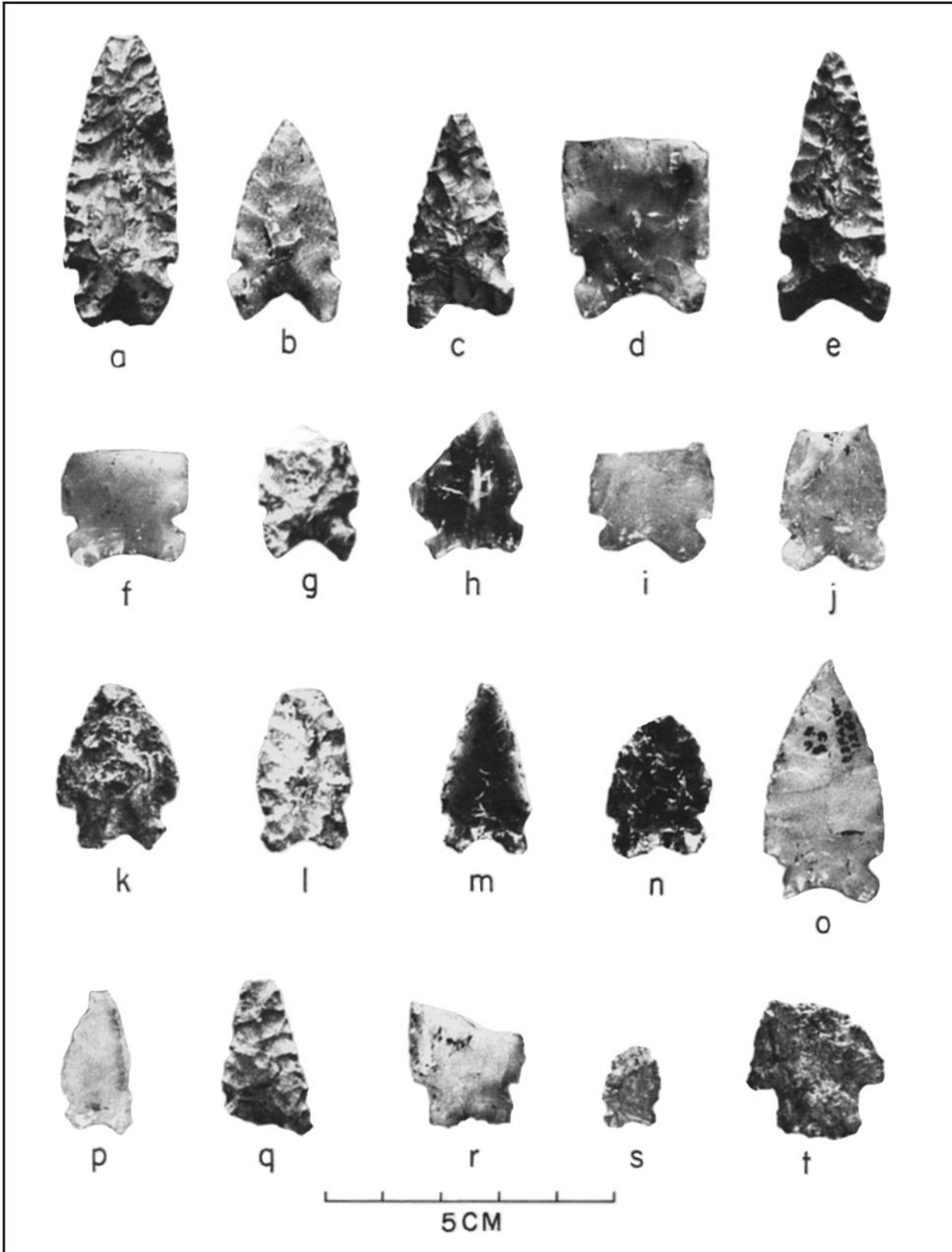


Plate 18. Projectile points, Layer 28: (a–h) laterally notched, indented base points; (i–q,s) eared, indented base points; (r) short stem, indented base point; (t) rectangular stem point.

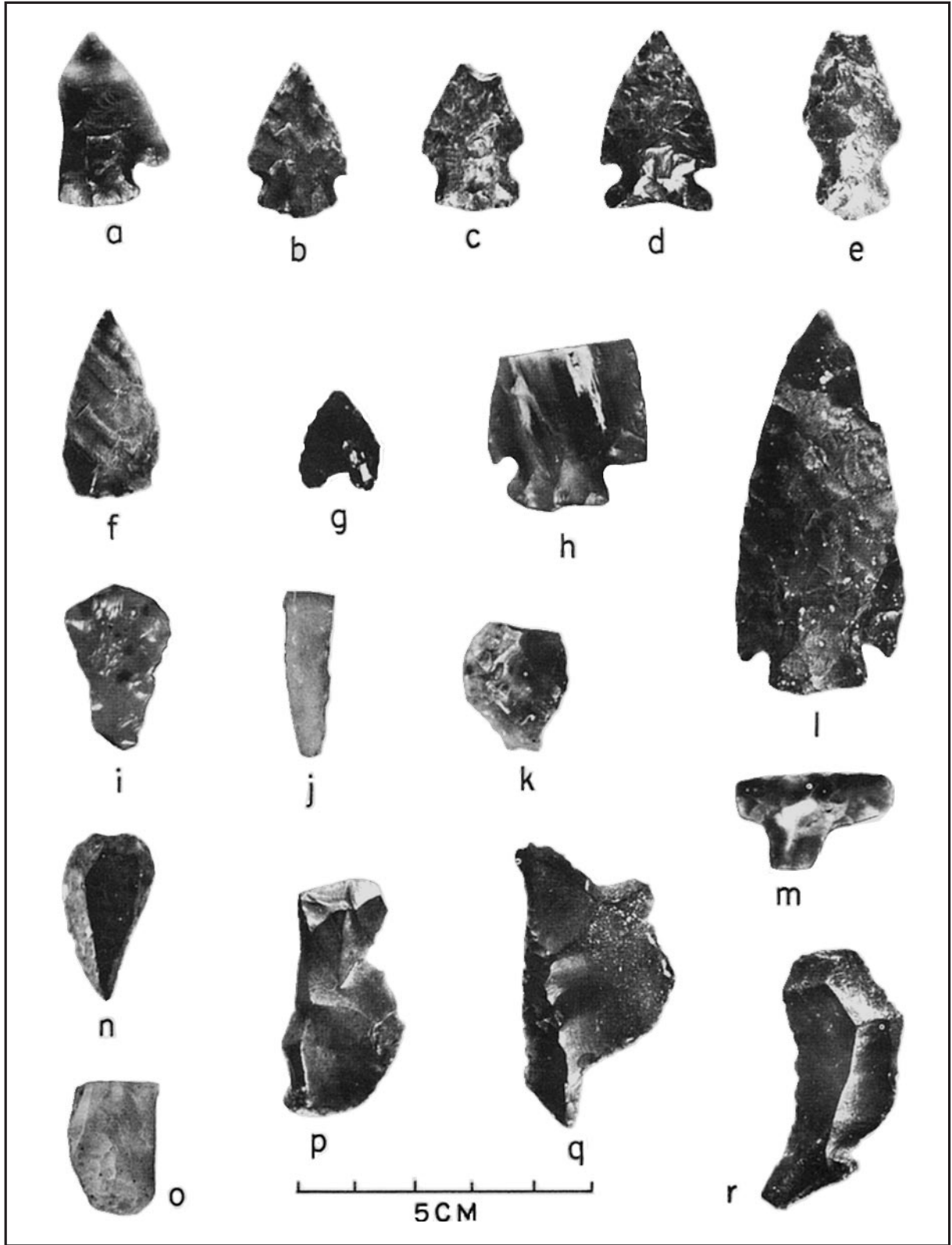


Plate 19. Projectile points and other chipped stone, Layer 28: (a,h,l) large corner-notched, convex base points; (b,c) small side-notched, convex base points; (d) side-notched, concave base point; (e) expanding stem, convex base point; (f) triangular, convex base point; (g) McKean Lanceolate point; (i,k) expanded base drills; (j) drill shaft; (m) t-shaped drill; (n) piriform graver; (o) utilized flake; (p-r) modified flakes.

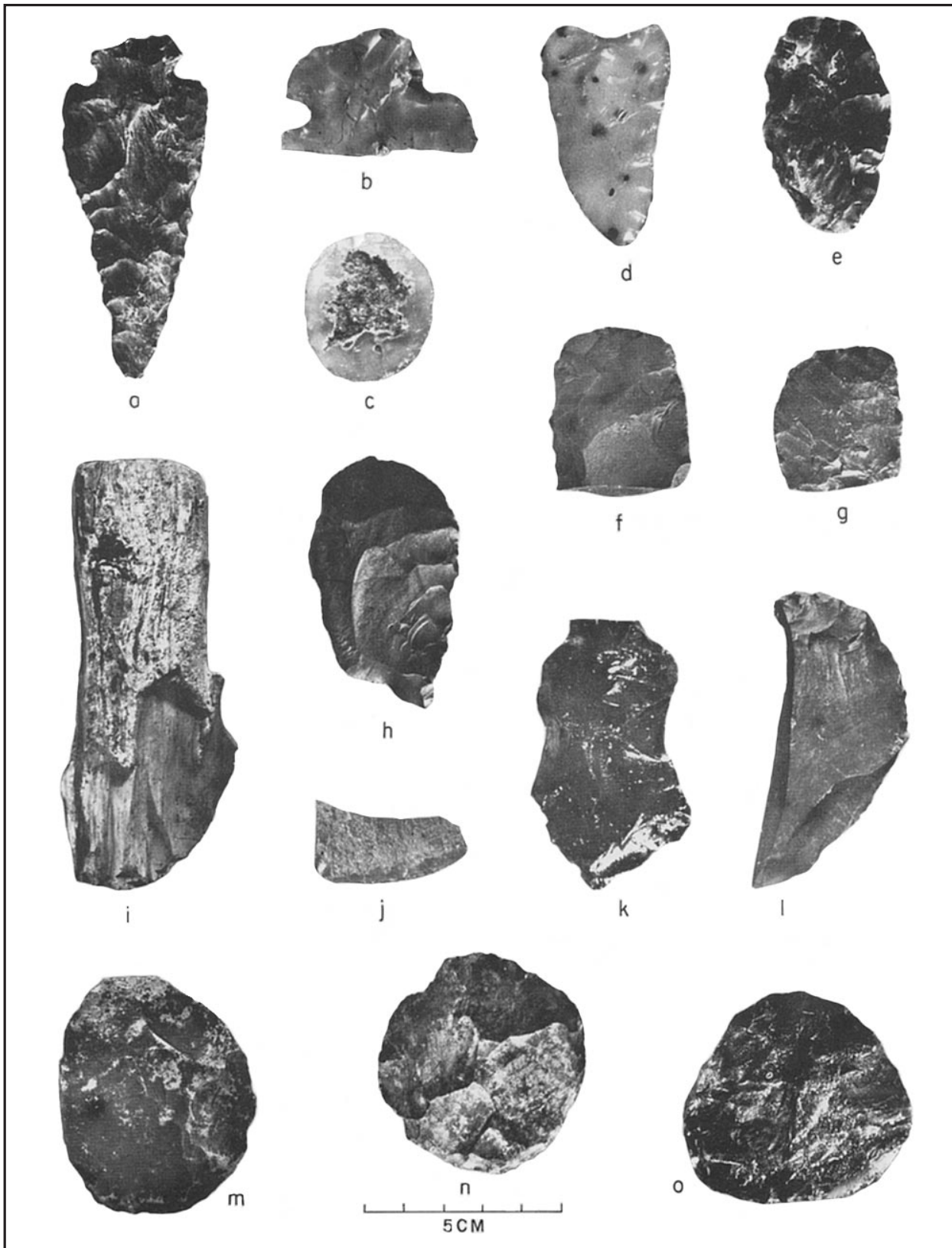


Plate 20. Chipped stone, Layer 28: (a,b) side-notched, convex base knives; (c,o) discoidal knives; (d) trianguloid, concave base knife; (e) elliptical knife; (f,g) proximal fragments of knives; (h) blank; (i) flake knife; (j) plate chalcedony knife; (k) spokeshave (?); (l) modified flake; (m,n) large discoidal scrapers.

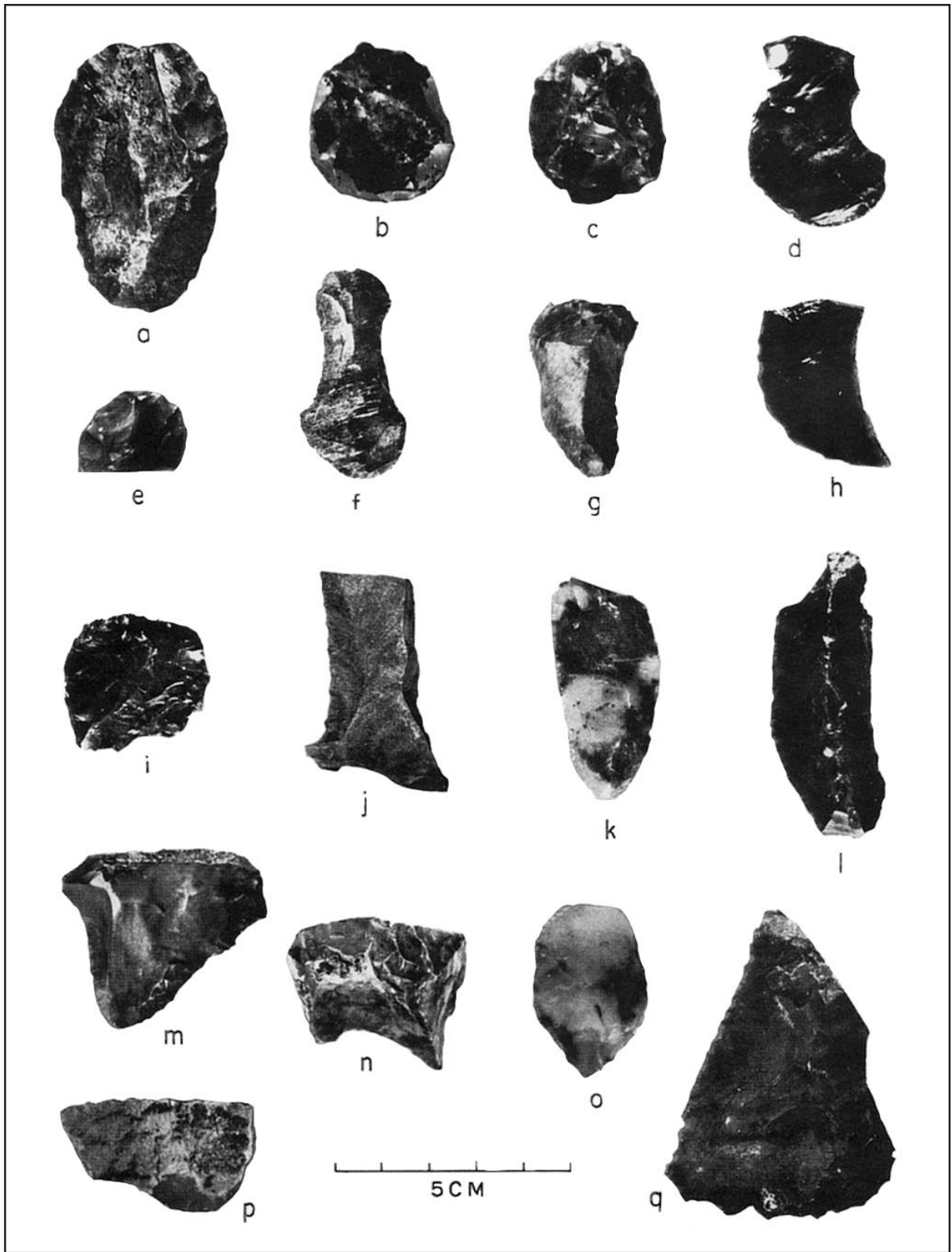


Plate 21. Chipped stone, Layer 28: (a) oval end scraper; (b,c) small discoidal scrapers; (d) concave scraper; (e,i) ovate knives; (f) stemmed scraper; (g,h) semi-lunate graters; (j-l) modified blades; (m,p,q) modified flakes; (n) flake graver; (o) ovate end scraper.

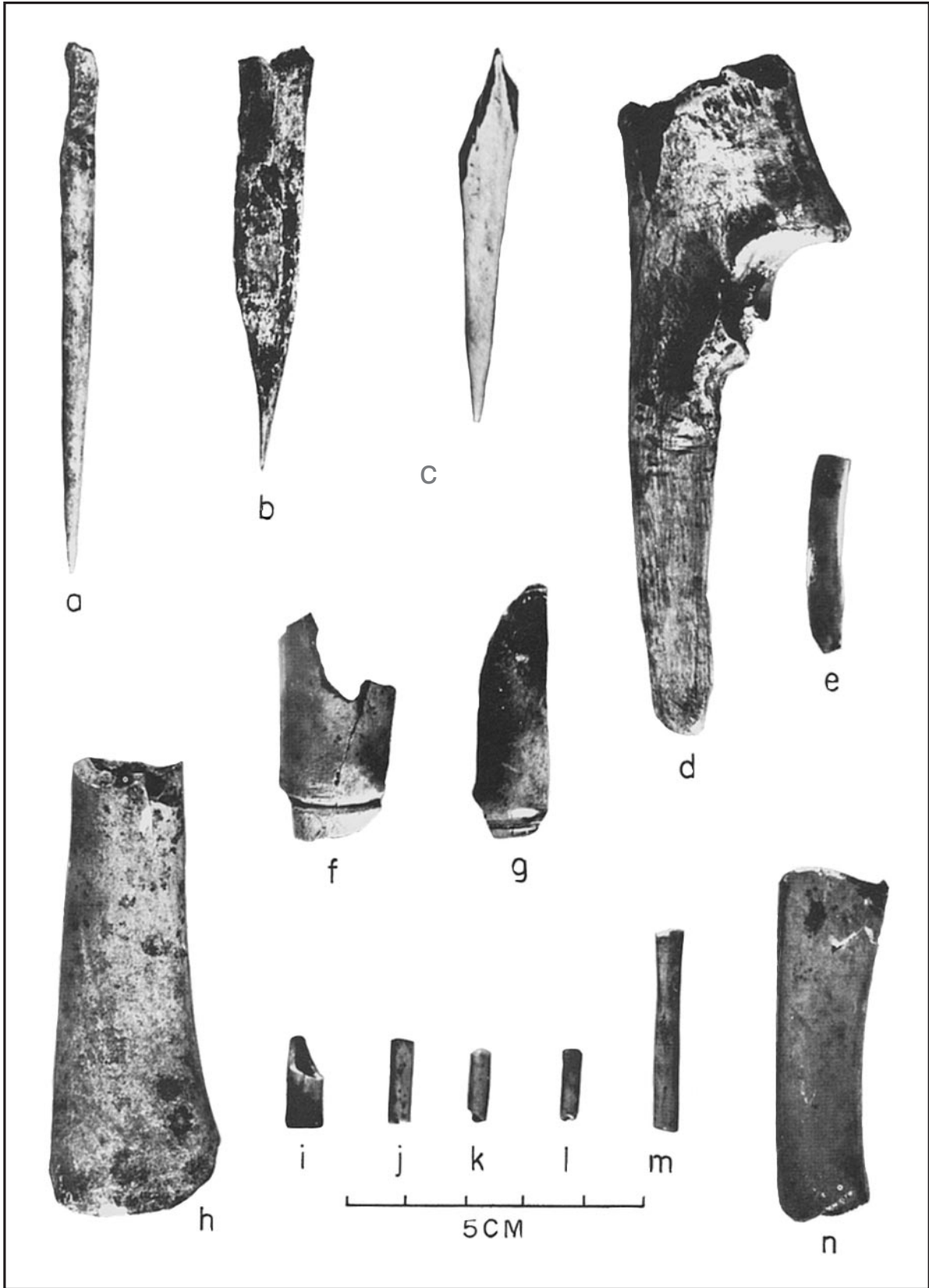


Plate 22. Bone, Layer 28: (a,c) splinter awls; (b) scapula awl; (d) ulna flaker; (e,i-m) beads; (f,g) grooved bones; (h,n) bone tubes.

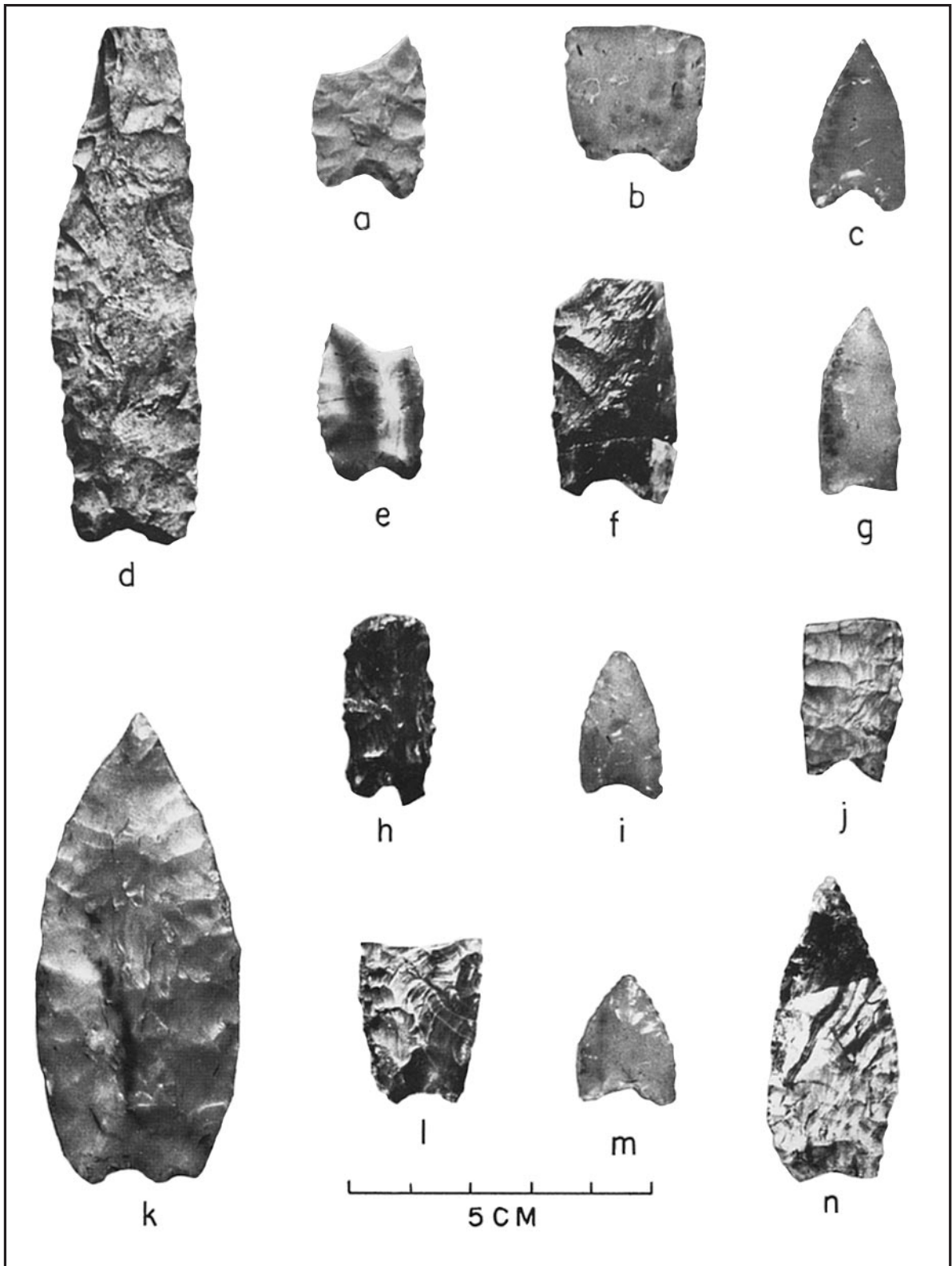


Plate 23. Projectile points, Layer 30: (a-n) McKean Lanceolate.



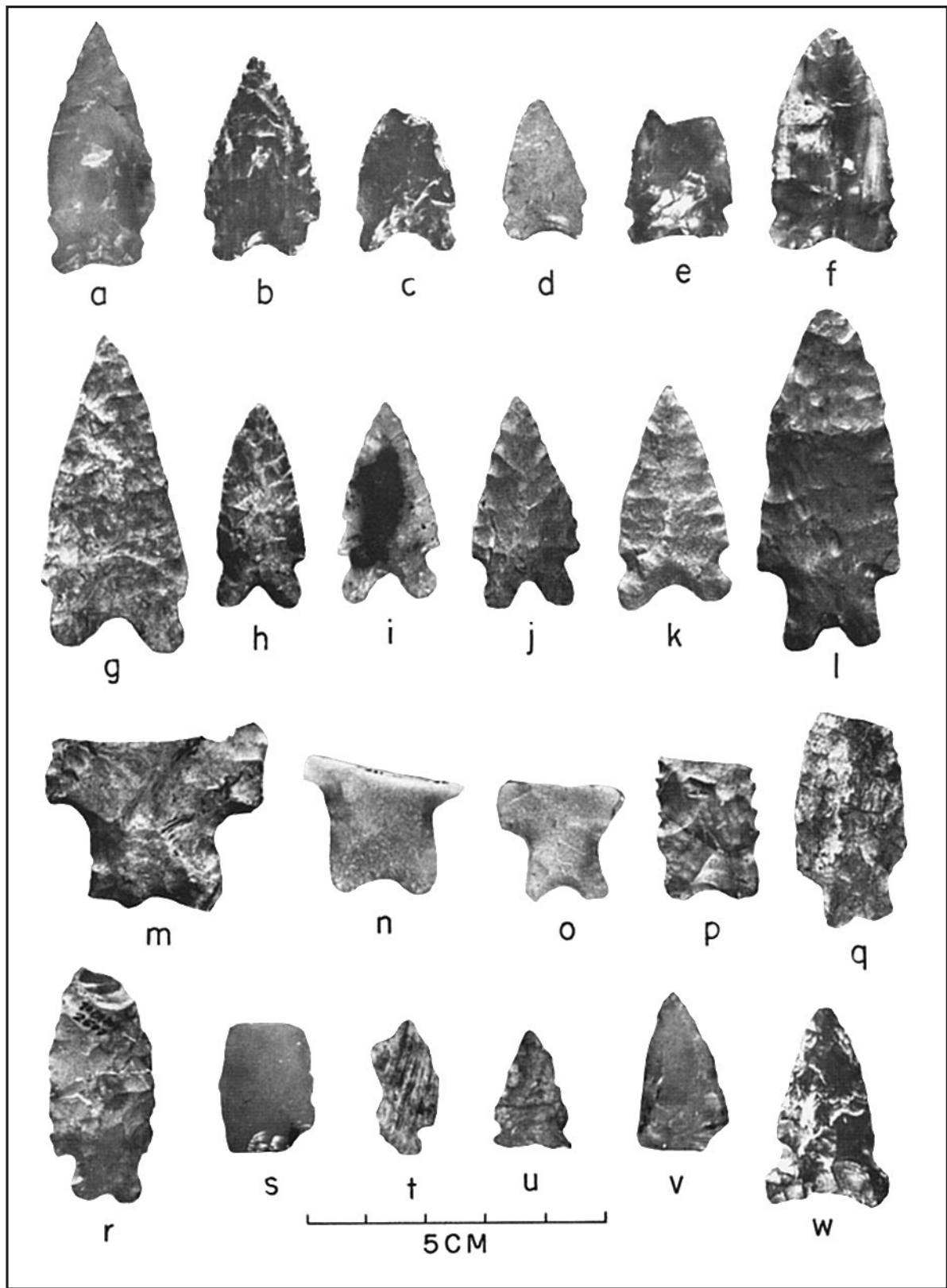


Plate 24. Projectile points, Layer 30: (a-f) eared, indented base; (g-k) expanding stem, notched base; (l-o) straight stem, indented base; (p-r) short stem, indented base; (s) miscellaneous; (t,u) crude eared, indented base; (v) crude trianguloid; (w) large side-notched, concave base.

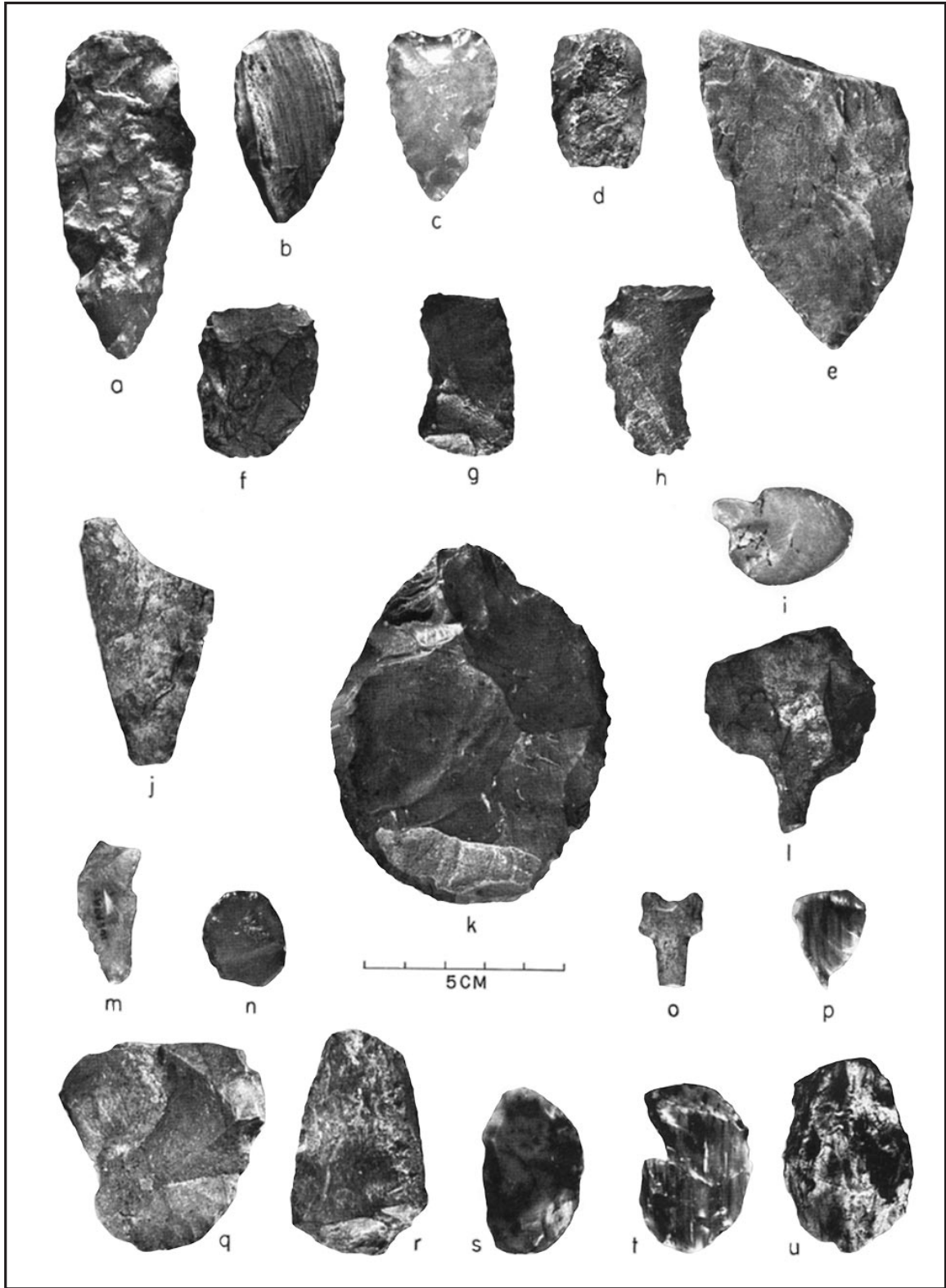


Plate 25. Chipped stone, Layer 30: (a) lanceolate knife; (b) crude ovate knife; (c) triangular knife; (d) plate chalcedony knife; (e) large ovate (?) knife; (f) crude trianguloid knife; (g) flake knife; (h) concave edged knife; (i) stemmed knife; (j) beveled knife; (k) large ovate scraper; (l) expanding stem drill; (m) denticulate flake; (n) small ovate knife; (o) stemmed, concave base drill; (p) flake drill; (q-s) crude end scrapers; (t) small ovate scraper; (u) crude side scraper.

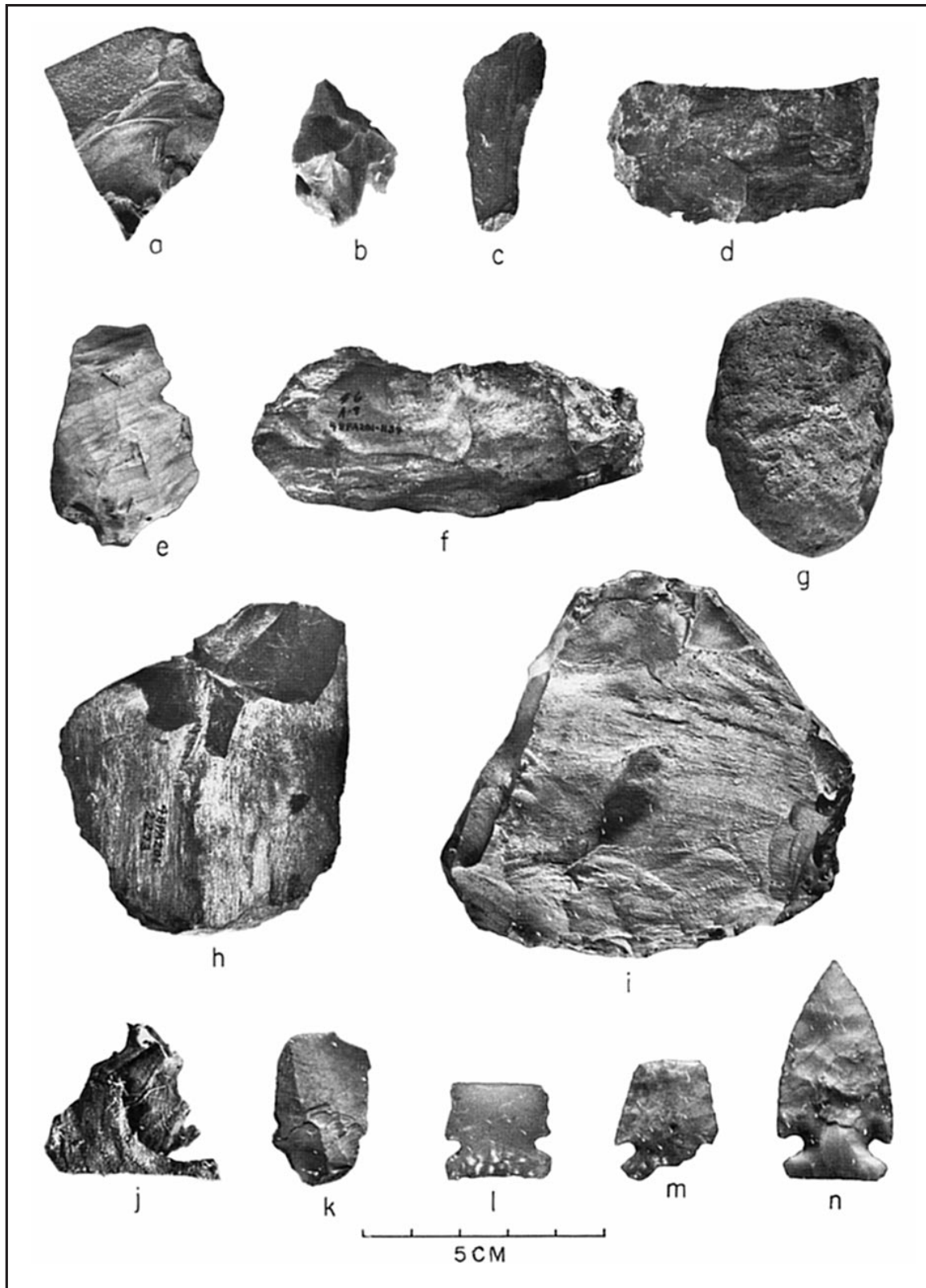


Plate 26. Chipped stone: (a,b) graters, Layer 30; (c–e) modified flakes, Layer 30; (f) knife chopper, Layer 30; (g) fired silt ball, Layer 30; (h,i) choppers, Layer 30; (j) tanned hide, Layer 30; (k) modified flake, Layer 22; (l) Pahaska Side-Notched point, Layer 19; (m) eared, notched base point, Layer 21; (n) large side-notched, straight base point, Layer 25.

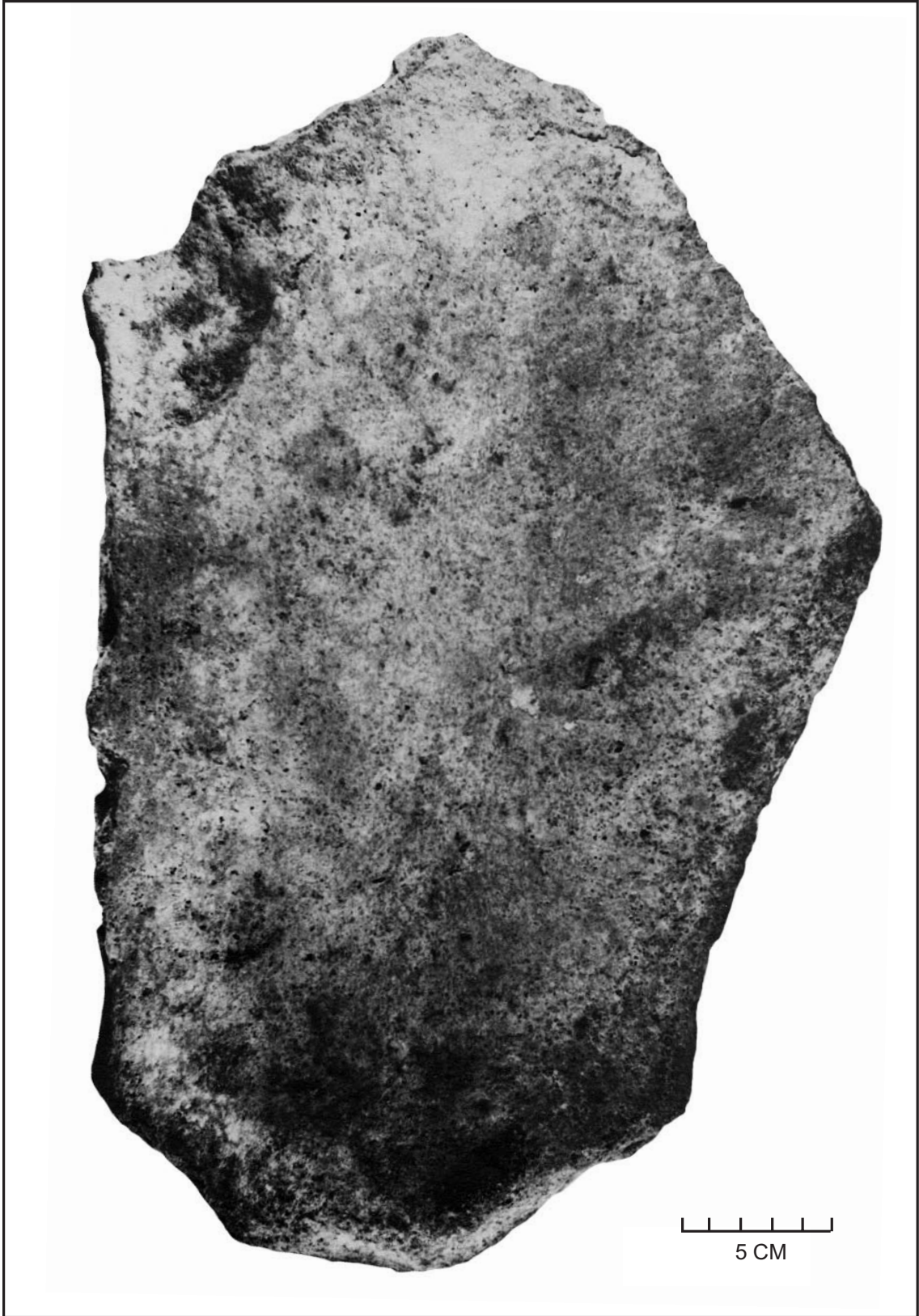


Plate 27. Grinding stone, Layer 30.

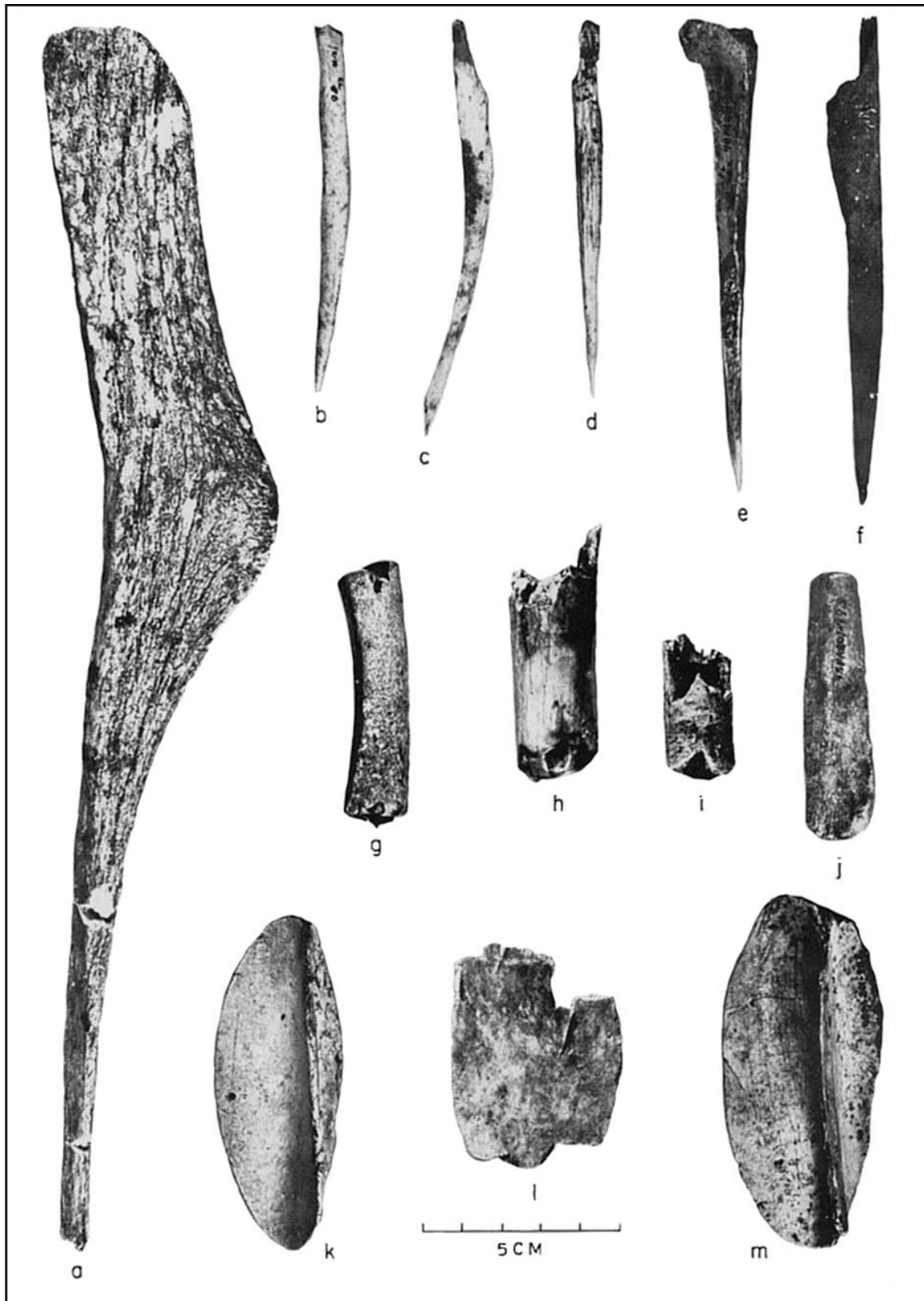


Plate 28. Bone and antler, Layer 30: (a) split antler flaker (?); (b) awl fragment; (c) splinter punch; (d,f) splinter awls; (e) L-shaped scapula awl; (g) plugged tube; (h,i) tubular pipes; (j) antler bar; (k,m) scapula knives (?); (l) smoothed scapula.

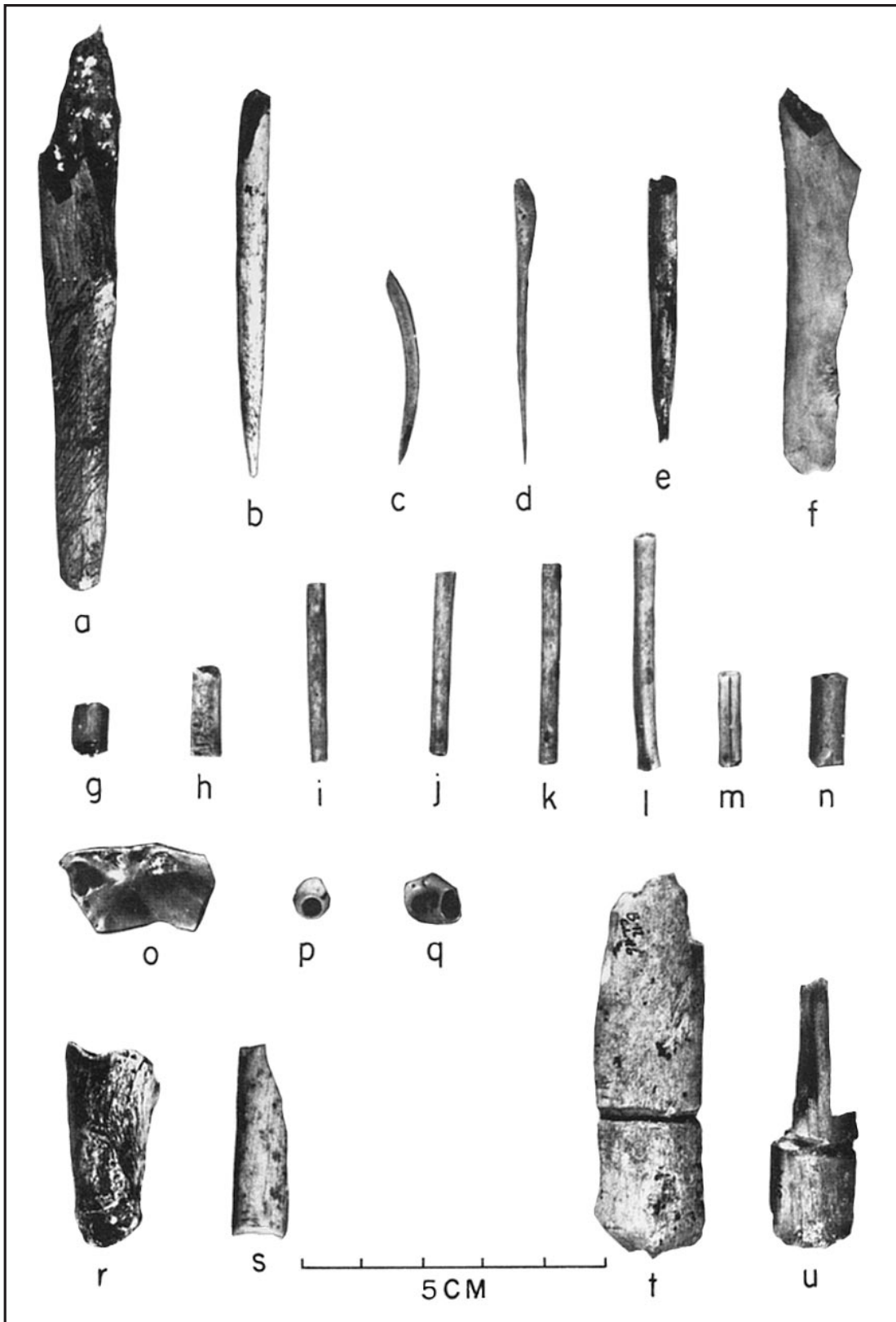


Plate 29. Bone and shell, Layer 30: (a,f) ulna flakers; (b,e) fine flakers; (c) rabbit incisor awl or punch; (d) small ulna awl; (g,h,n) bone beads (i-m) rabbit phalange beads; (o) fragment of shell; (p,q) shell beads; (r) phalanx tube; (s) bone tube fragment; (t,u) grooved bone.

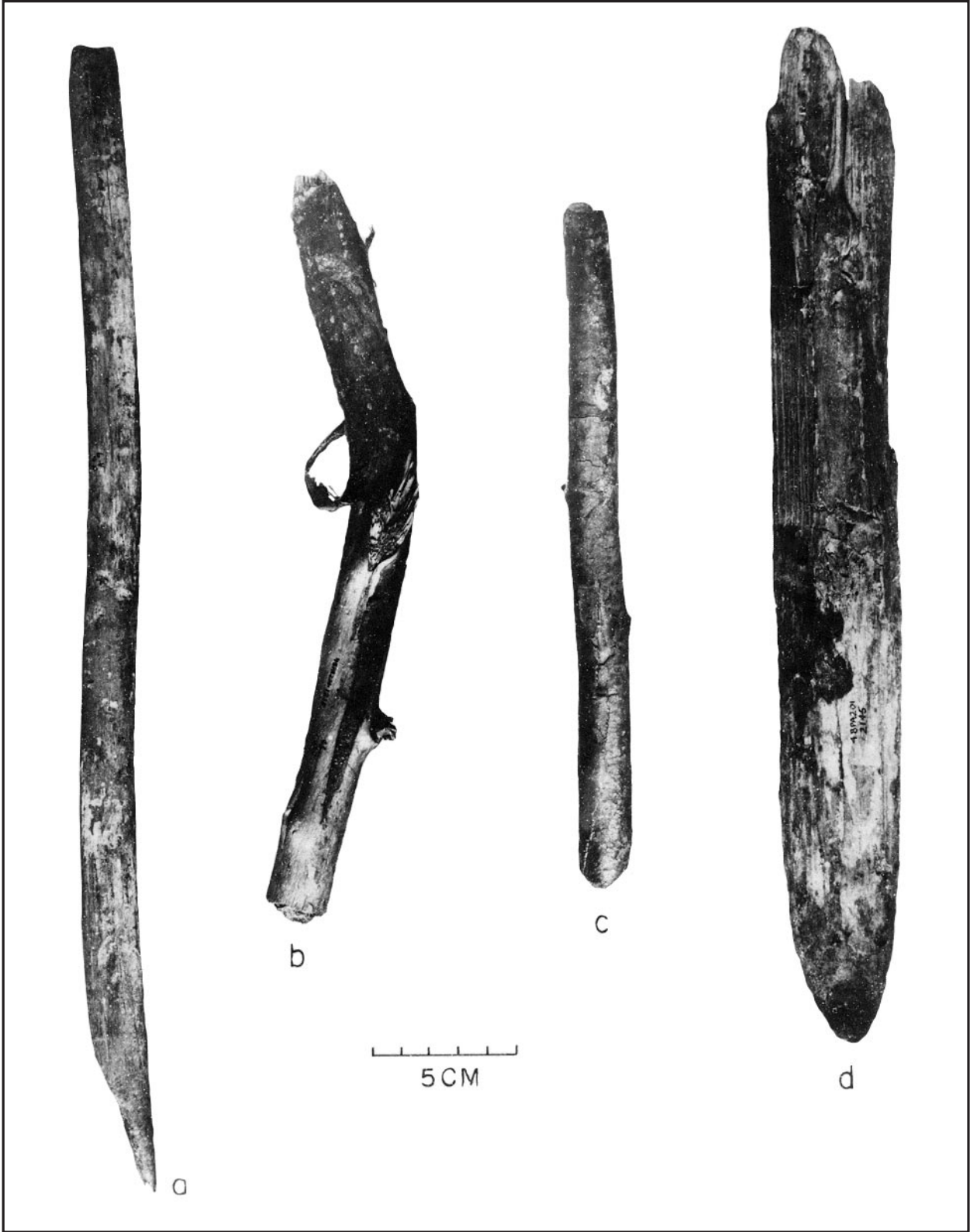


Plate 30. Wood, Layer 30: (a,d) digging sticks; (b,c) cut wood.

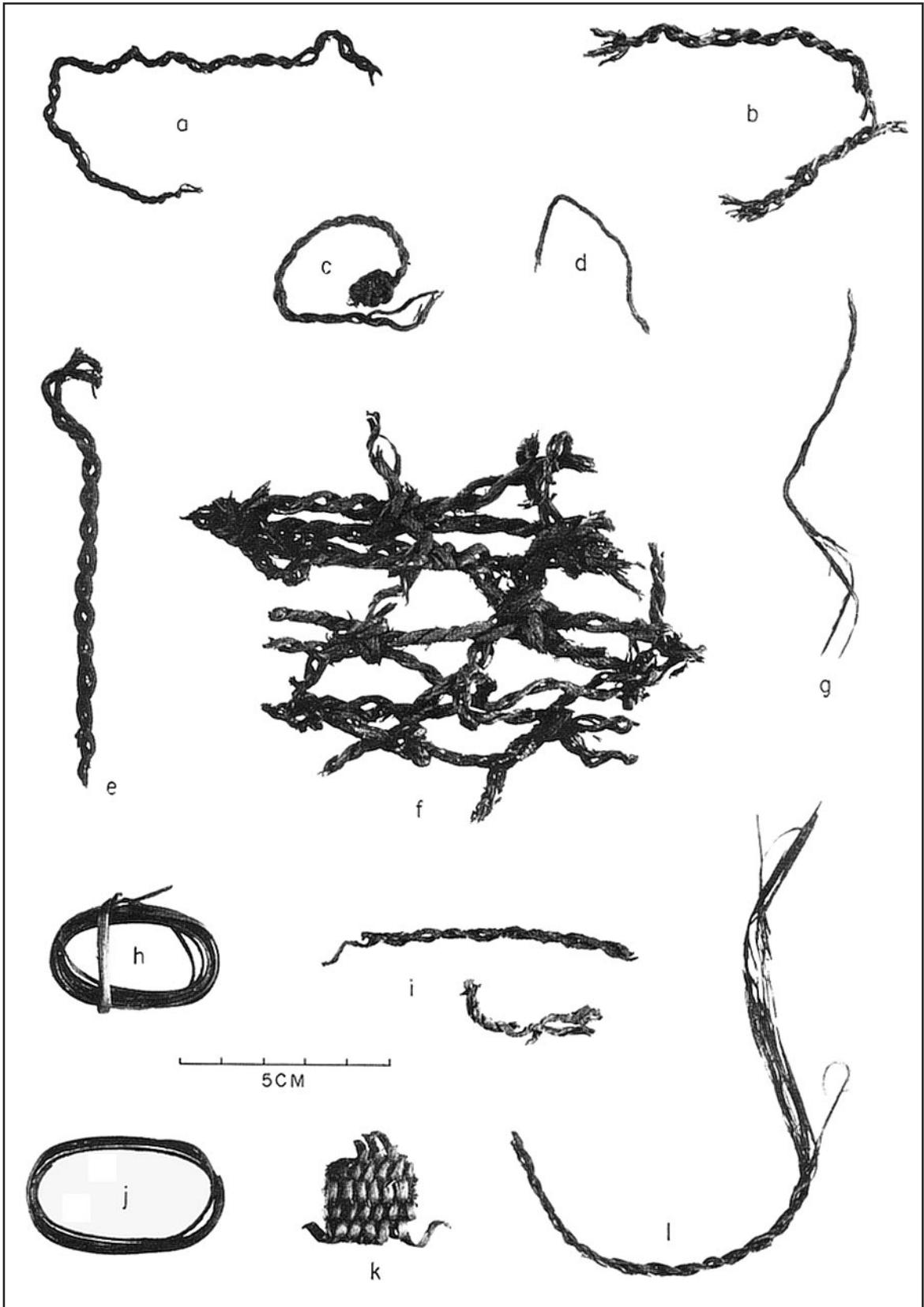


Plate 31. Plant fiber: (a–g) cordage, Layer 30; (h,j) basketry stitching, Layer 30; (i) cordage, Layer 32; (k) coiled basketry, Layer 30; (l) cordage, Layer 34.



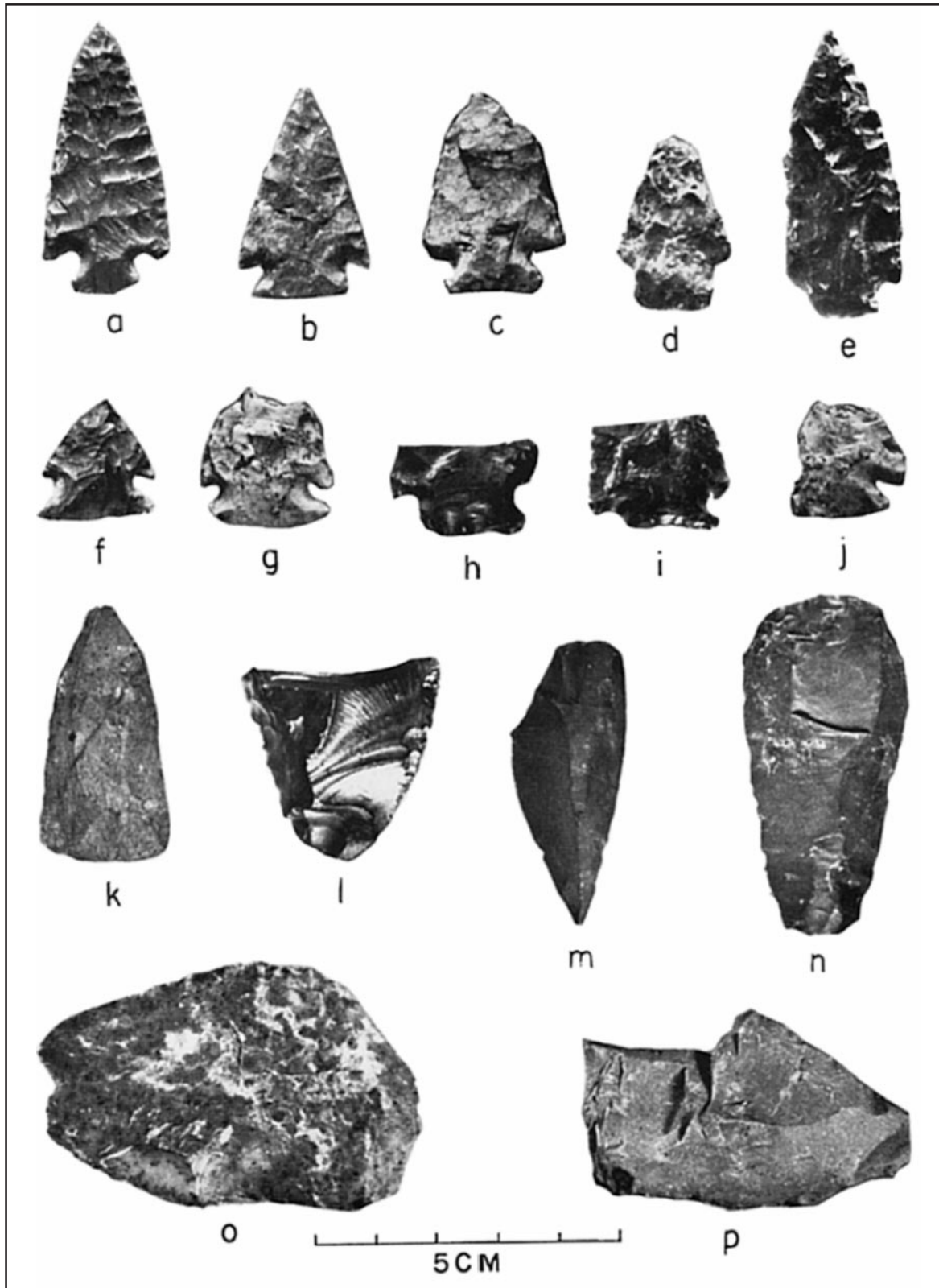


Plate 32. Chipped stone, Layer 32: (a,e) corner-notched, convex base, narrow stem points; (b-d,f-j) corner-notched, straight base, wide stem points; (k,o) modified flakes; (l) knife fragment; (m) graver; (n) gouge; (p) side scraper.

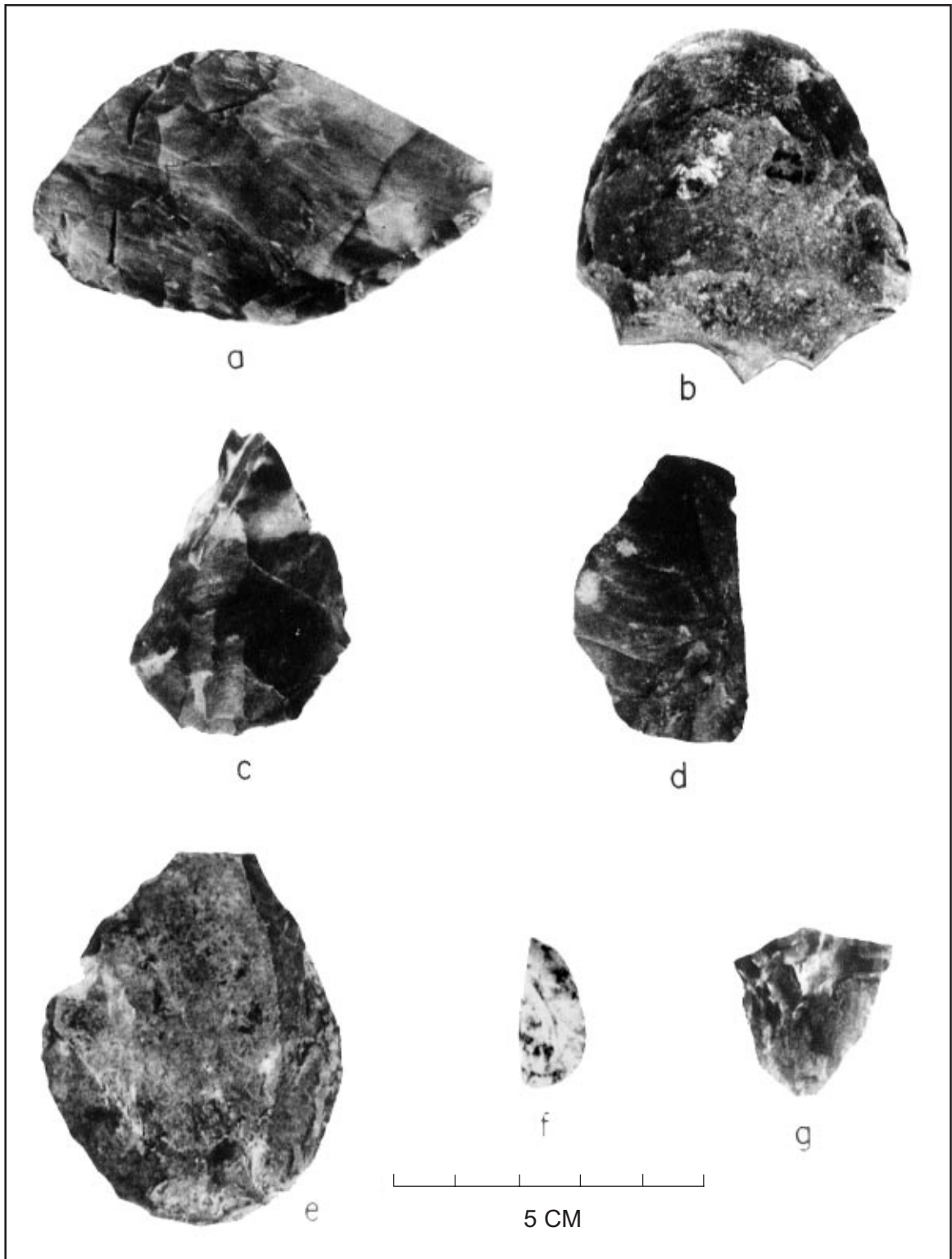


Plate 33. Chipped stone: (a) lozenge shaped knife, Layer 32; (b) end scraper, Layer 32; (c) chopper, Layer 32; (d) modified flake, Layer 32; (e) ovate end scraper, Layer 34; (f) side scraper, Layer 32; (g) knife fragment, Layer 32.

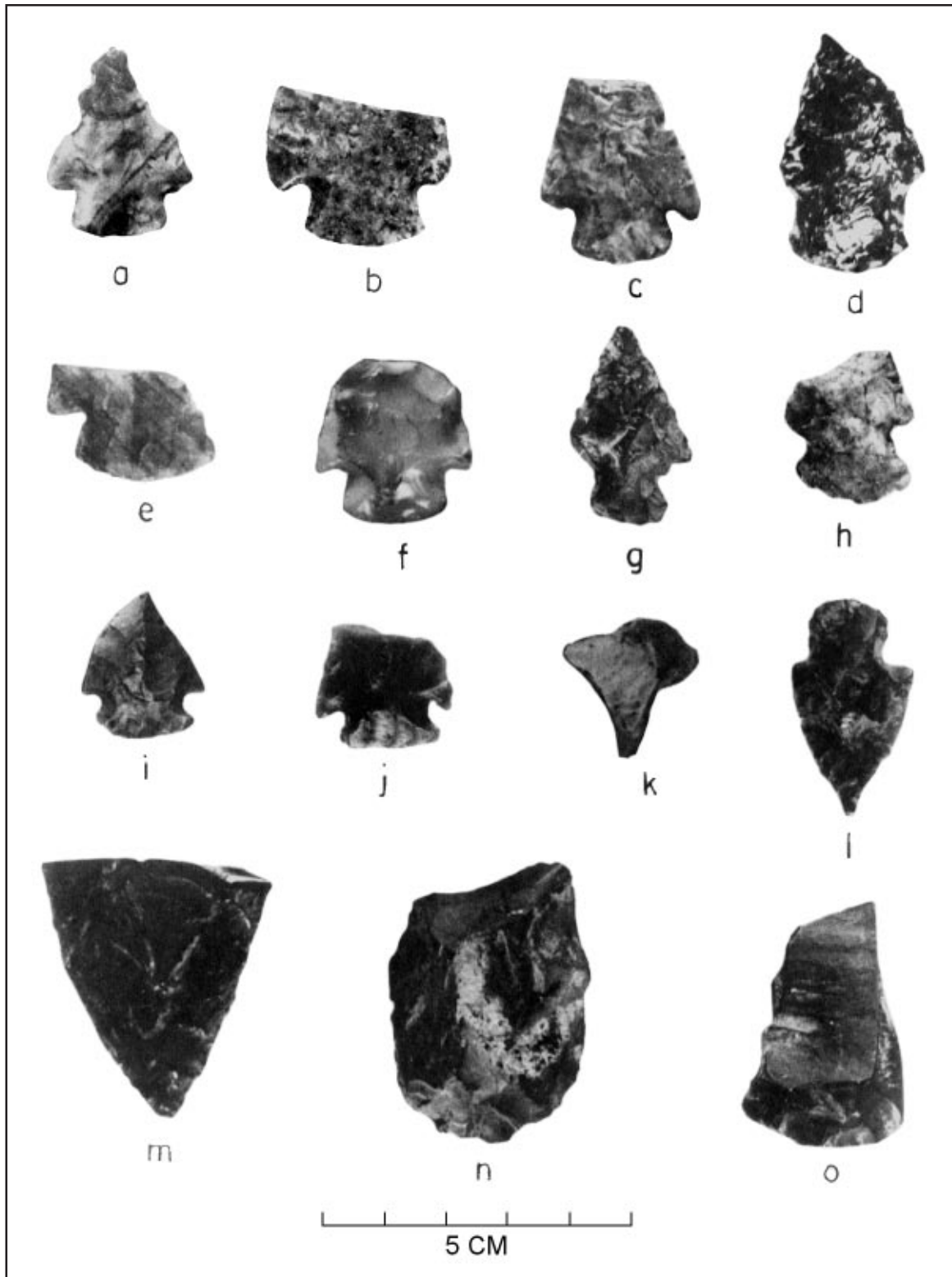


Plate 34. Chipped stone, Layer 34: (a–i) corner-notched, convex base, side stem points; (j) corner-notched, straight base, wide stem point; (k) Y-shaped graver; (l) drill; (m) knife fragment; (n) blank; (o) modified flake.



Plate 35. Bone, wood and shell: (a,b) flakers, Layer 32; (c,i) awl tips, Layer 34; (d) flaker tip, Layer 34 (e,f) cut wood, Layer 34; (g,h) shaft discard, Layer 34; (j) shell bead, Layer 34; (k) end of foreshaft, Layer 34.

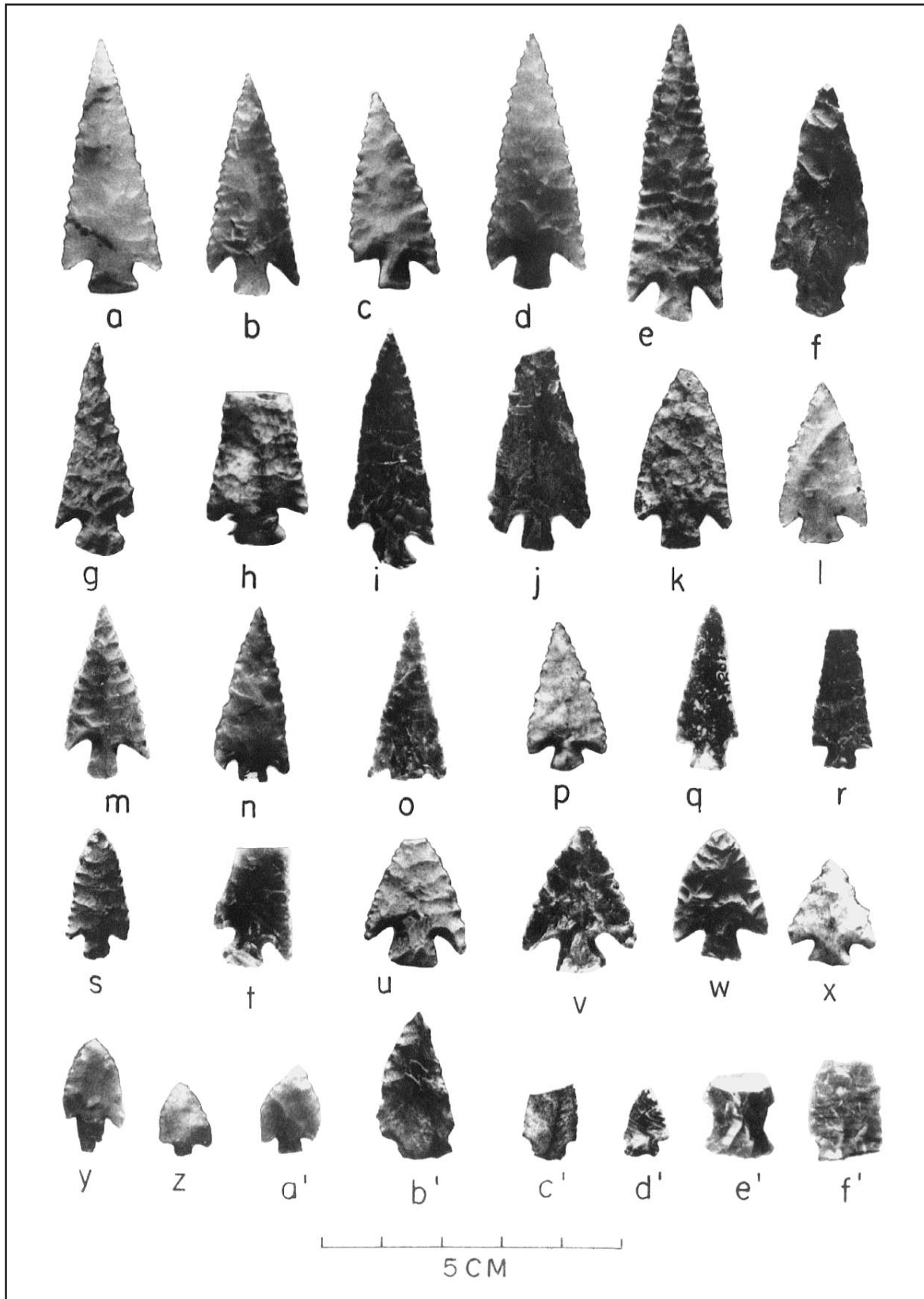


Plate 36. Projectile points, Layer 36: (a-x) Rose Spring Corner-Notched; (y-a',d') miniature; (b',c') crude flake; (e') thick side-notched, convex base; (f') side-notched, straight or concave base.

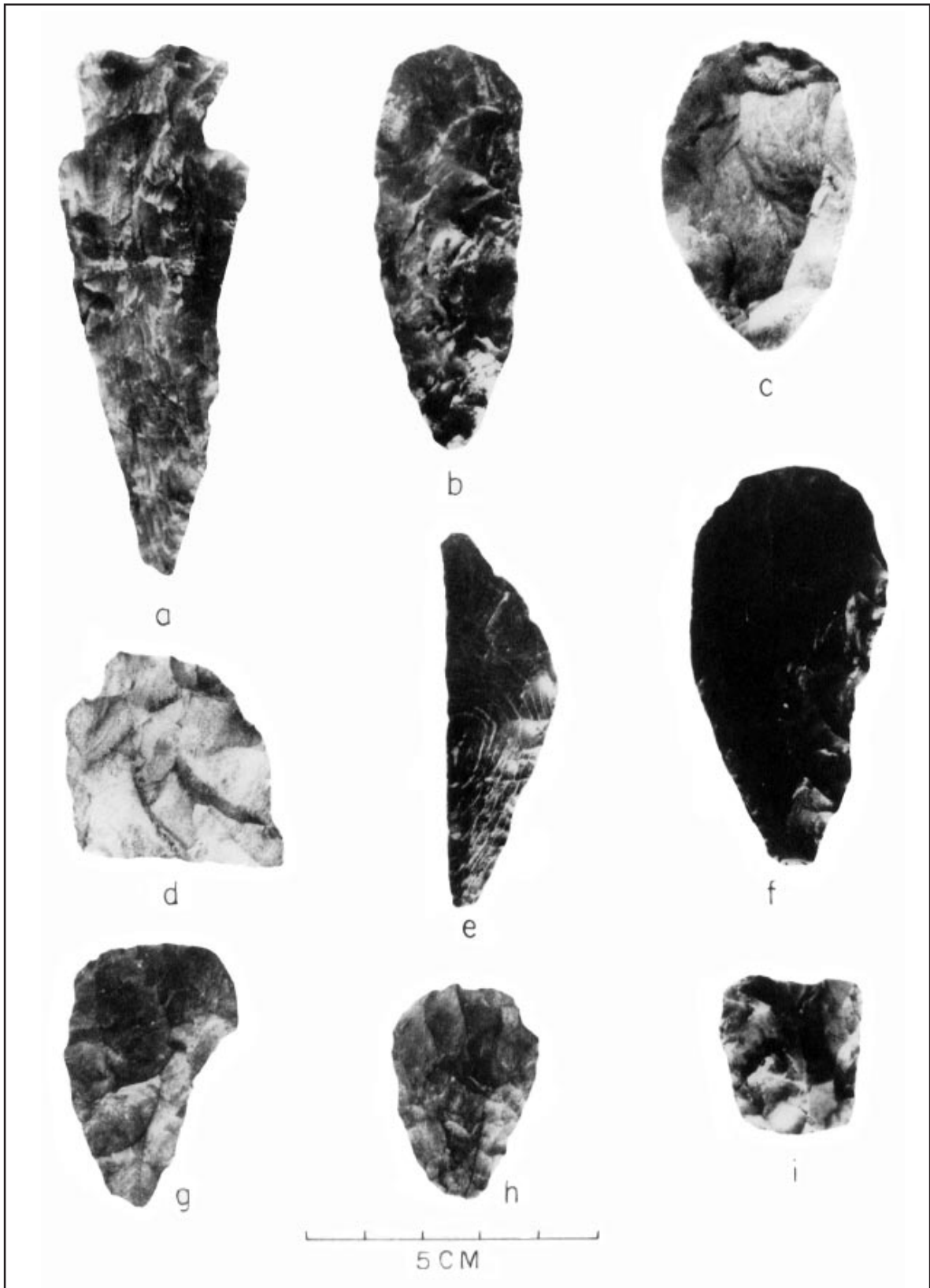


Plate 37. Knives, Layer 36: (a) corner-notched; (b) lanceolate; (c,d) ovate; (e) long, narrow; (f,g) asymmetric; (h) triangular, convex base; (i) triangular, straight base.

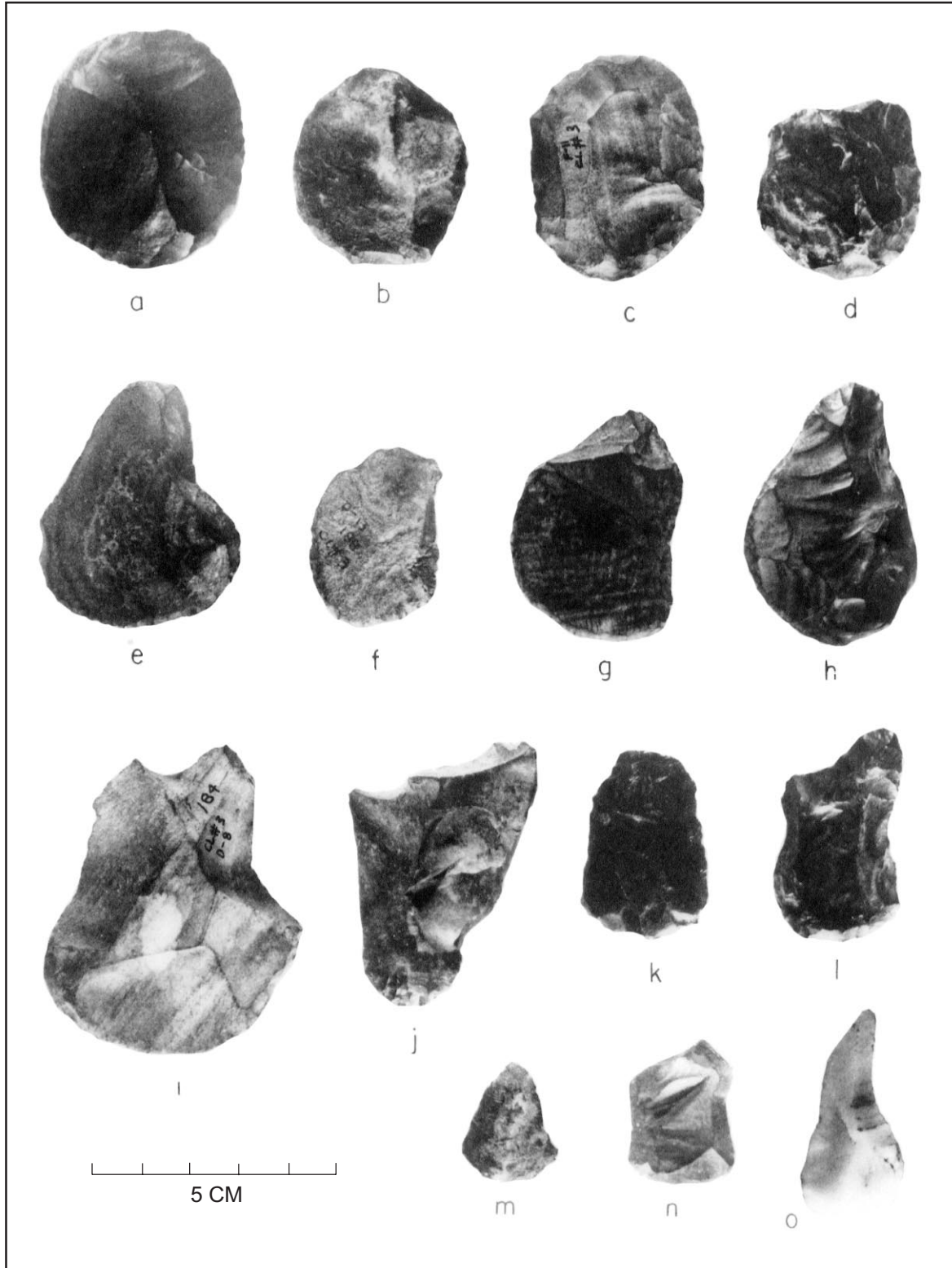


Plate 38. End scrapers, Layer 36: (a-d) oval; (e-i) flake; (j) crude end scraper-graver; (k) end scraper-graver; (l,n,o) tanged; (m) triangular.

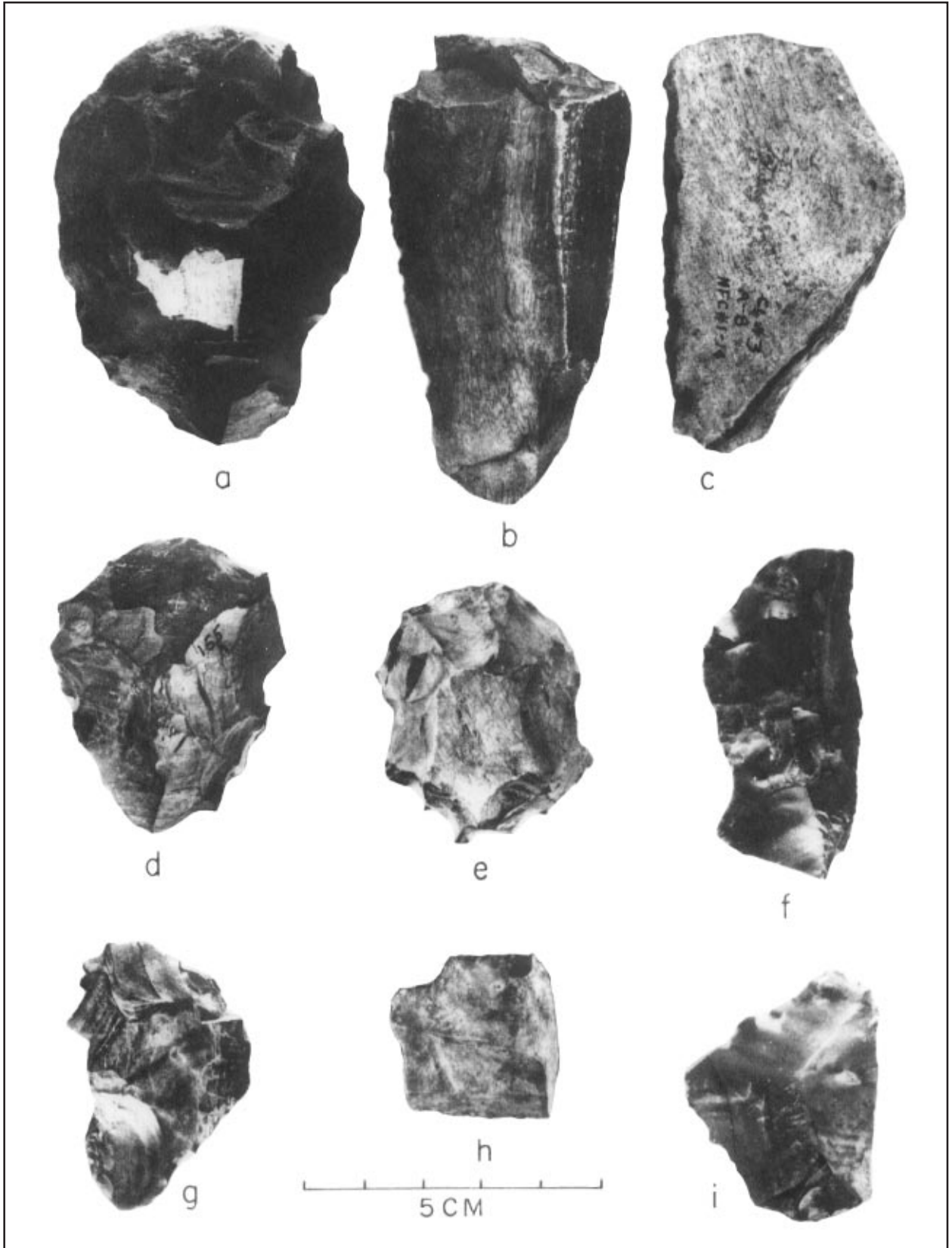


Plate 39. Scrapers and modified flakes, Layer 36: (a) crude ovate scraper; (b,c) side scrapers; (d,e) scraper planes; (f-i) modified flakes.



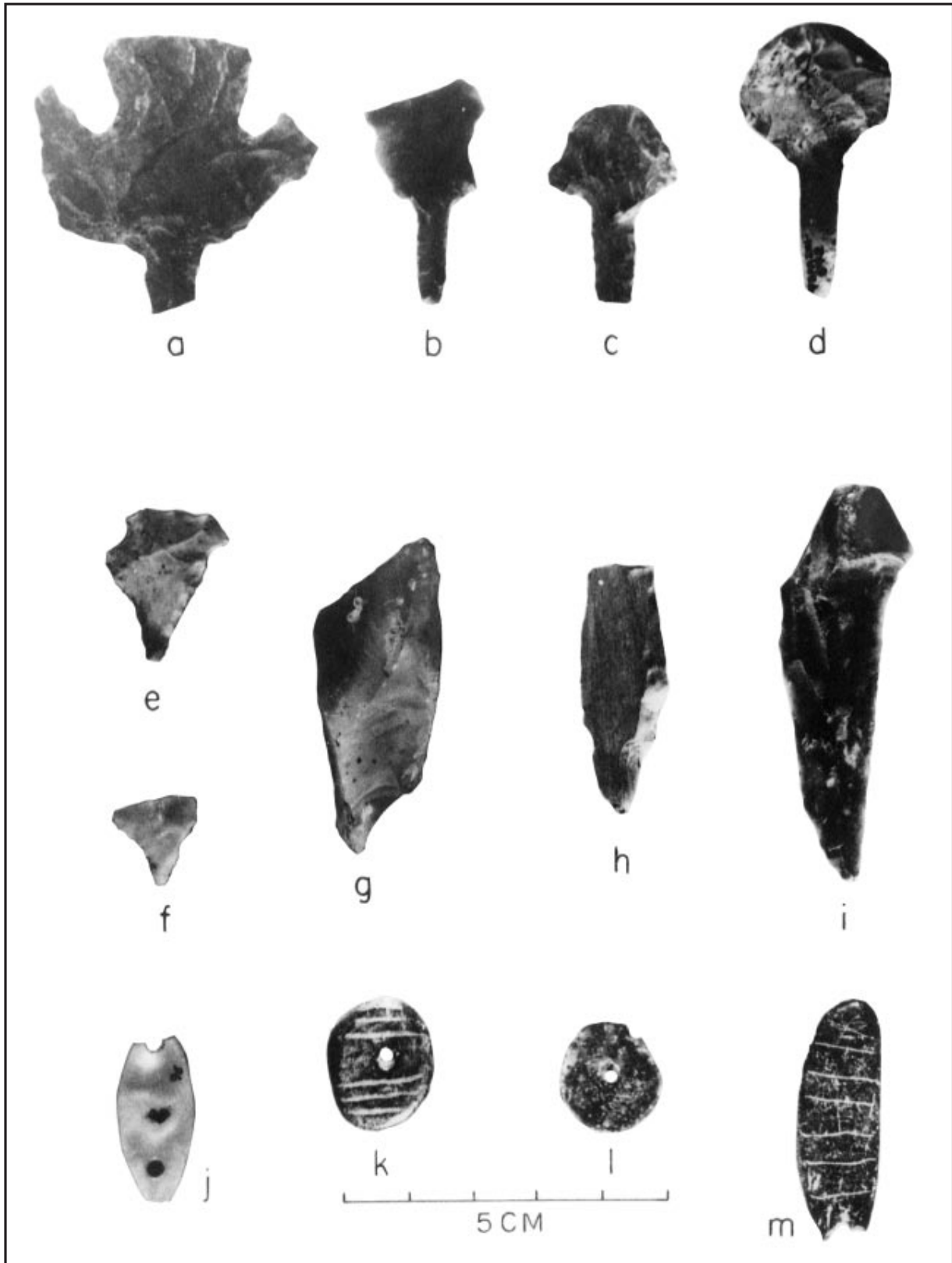


Plate 40. Chipped and polished stone, Layer 36: (a) corner-notched drill; (b–d) expanded base drills; (e,f) trianguloid graters; (g) trapezoidal graver; (h,i) blade graters; (j) shell pendant; (k–m) stone pendants or beads.

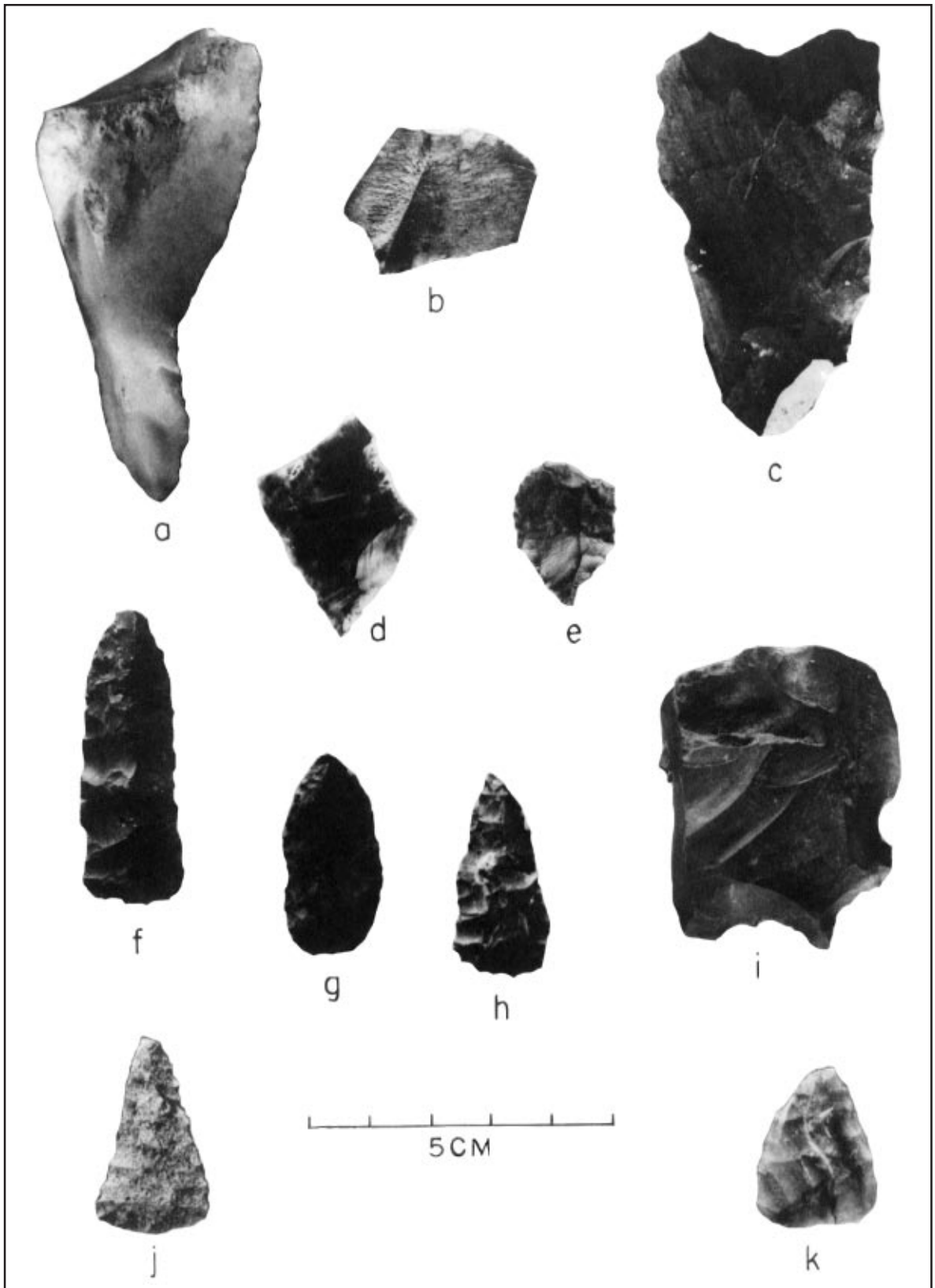


Plate 41. Gravers and blanks, Layer 36: (a) blade graver; (b,d,e) flake graters; (c) large trianguloid blank; (f) small lanceolate blank; (g) small ovate blank; (h,j) small triangular blanks; (i) rectangular graver; (k) short trianguloid blank.

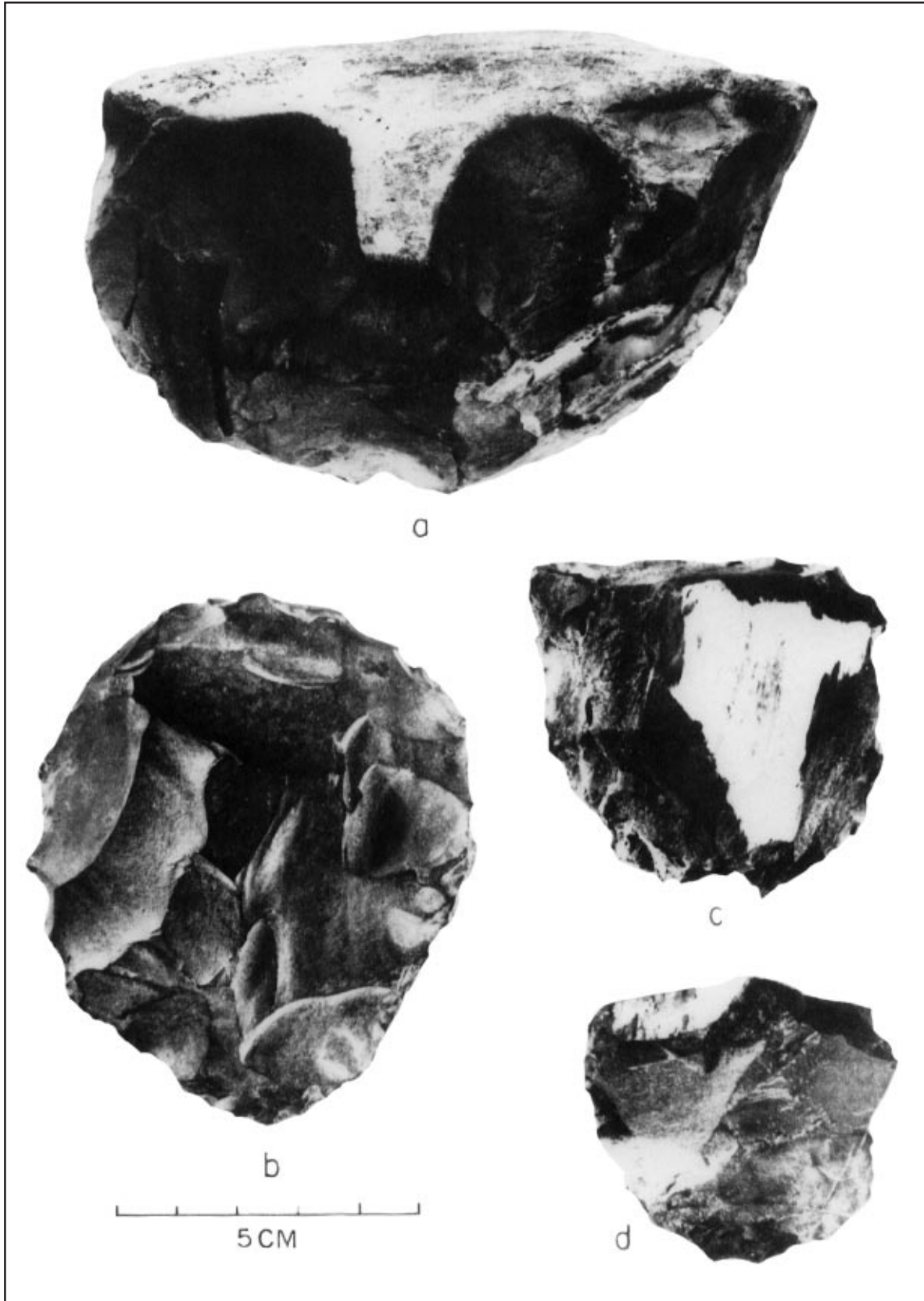


Plate 42. Choppers, Layer 36: (a) semi-circular; (b) oval; (c,d) crude ovate.

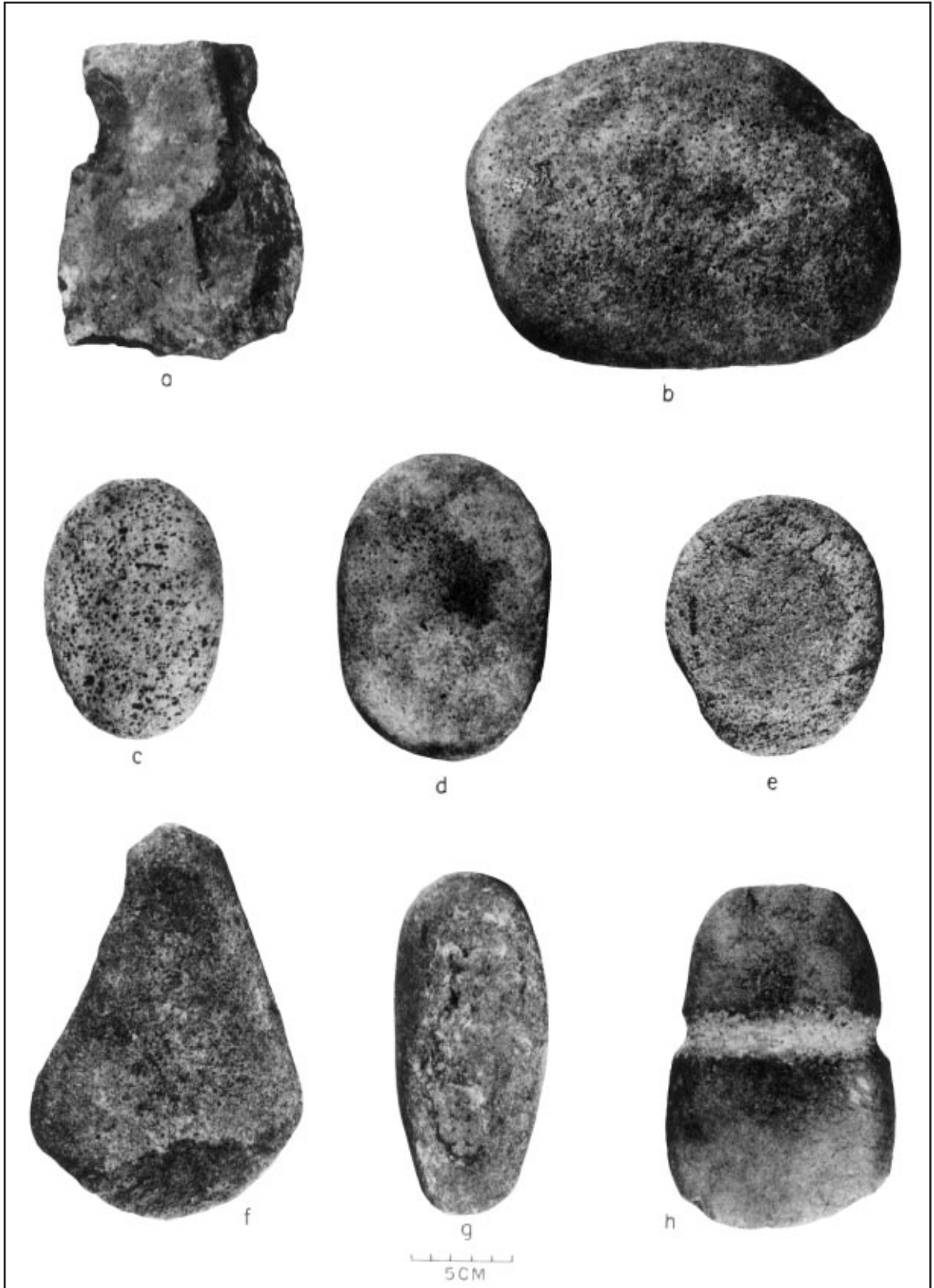


Plate 43. Rough stone, Layer 36: (a) notched slab axe; (b) cobble anvil; (c,e) hand stones; (d) edge ground cobble; (f) cobble chopper; (g) hammerstone; (h) grooved cobble axe.

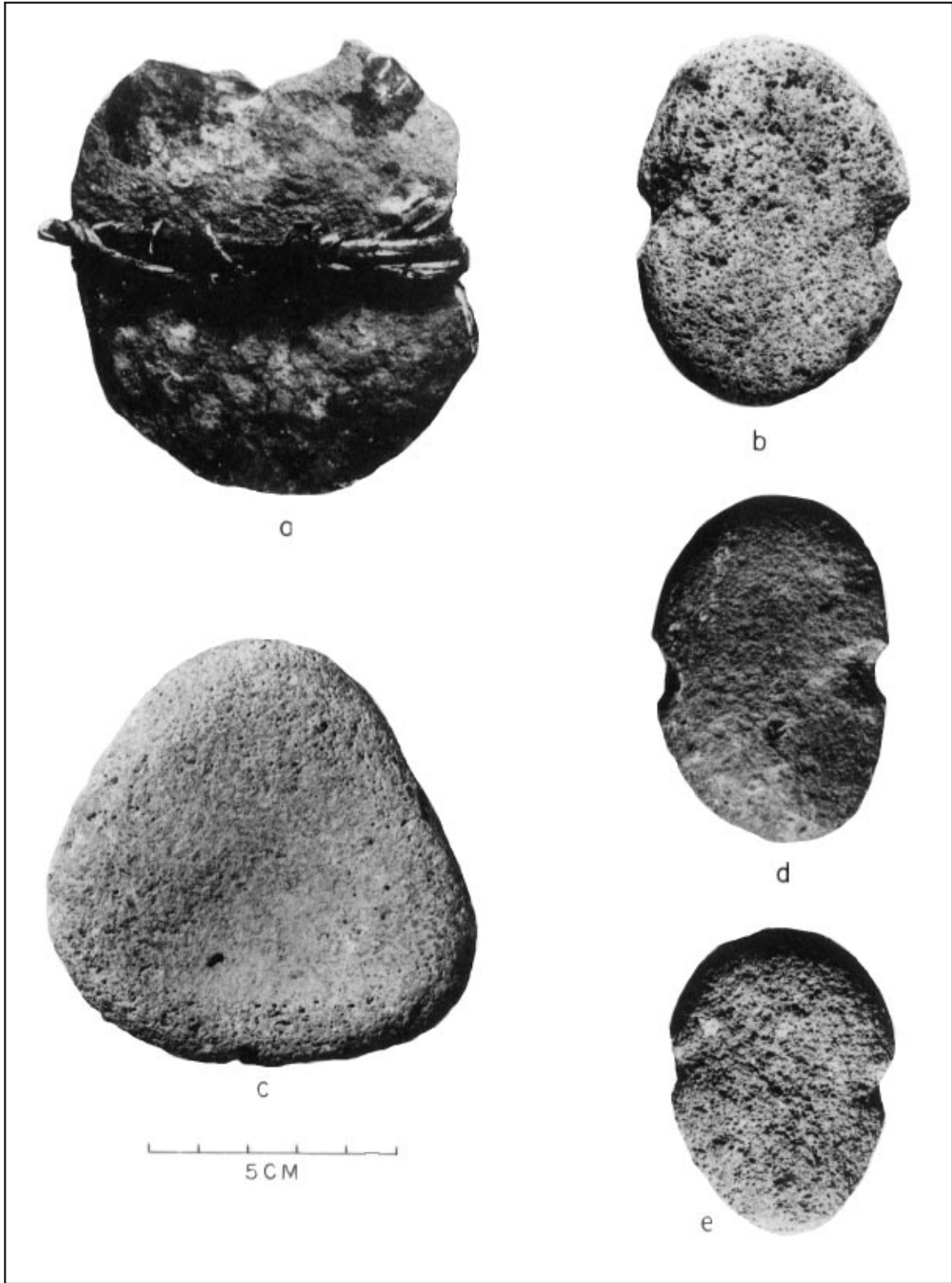


Plate 44. Rough stone, Layer 36: (a) wrapped and tied spall; (b,d,e) notched pebbles; (c) painted pebble.



Plate 45. Rough stone, Layer 36: (a,b) grinding slabs.



Plate 46. Bone, Layer 36: (a) tibia awl; (b) decorated awl; (c) perforated awl; (d-f) scapula awls; (g) splinter awl; (h) rib awl; (i,j,l) splinter flakers; (k) broken awl.



Plate 47. Bone and antler, Layer 36: (a) scapula saw; (b) laterally barbed point; (c,e) antler flakers (d) wedge-like implement; (f) broken antler; (g) antler tine; (h) bear canine tooth; (i) split beaver incisor; (j,k) bone pendants; (l) bone bead; (m) smoothed horn.





Plate 48. Wood and reed, Layer 36; (a–e,i–k) arrowshaft parts; (f–h,l) arrowshaft discard sections; (m–o) shaft slotting discards; (p,q) foreshaft slotting discards; (r,s) reed discards.



Plate 49. Wood, Layer 36: (a) knife handle; (b) tenoned shaft discard; (c) trap or snare part (?); (d) fire drill; (e) smoothed stick; (f) whittled stick; (g) skewer or awl (?); (h) toy bow.



Plate 50. Wood, Layer 36: (a,b) knobbed sticks; (c–g,i) cut wood; (h) curved stick; (j) tenoned stick.

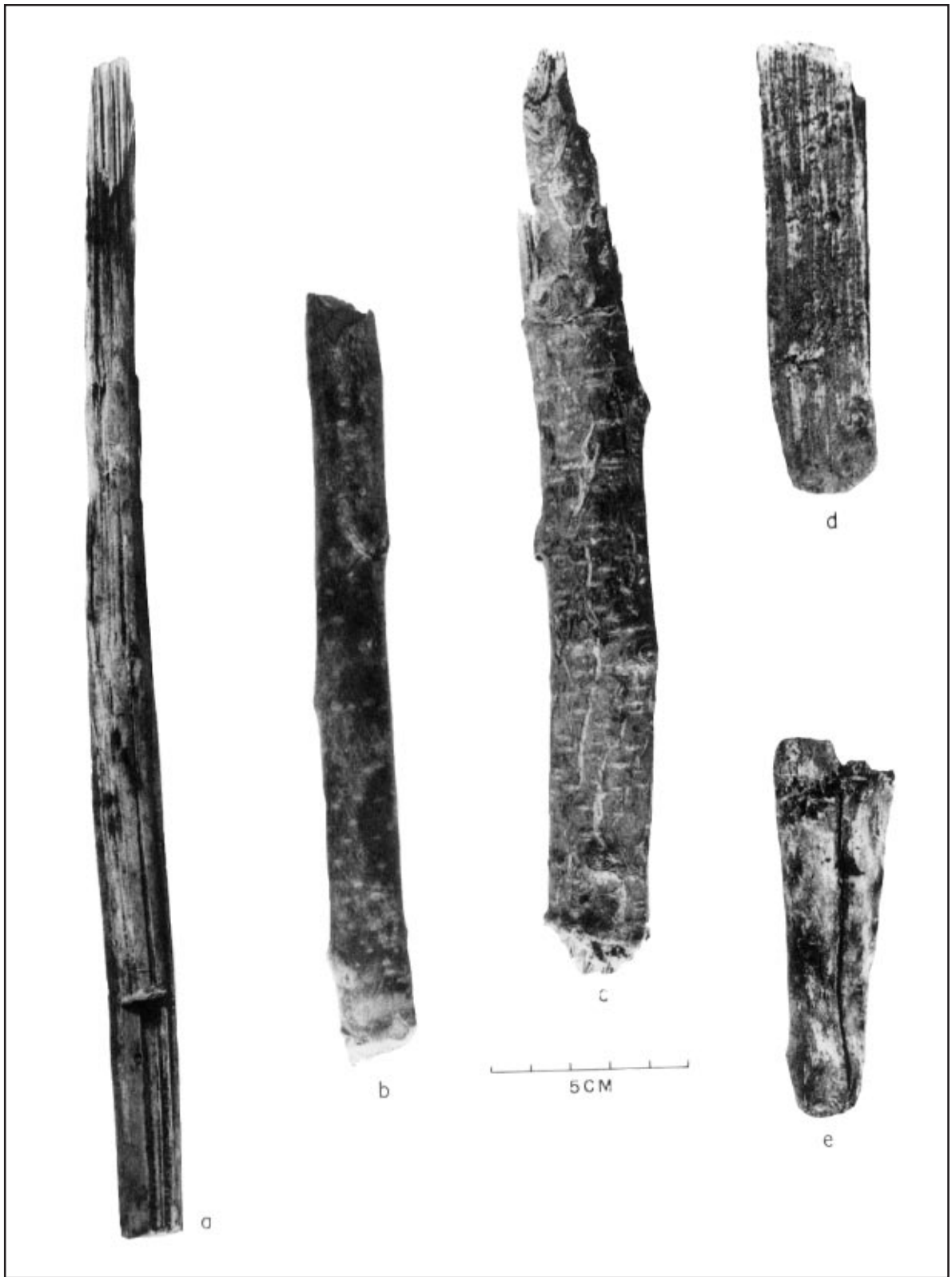


Plate 51. Wood, Layer 36: (a) cut and split; (b,c) cut; (d,e) ends of digging sticks (?).

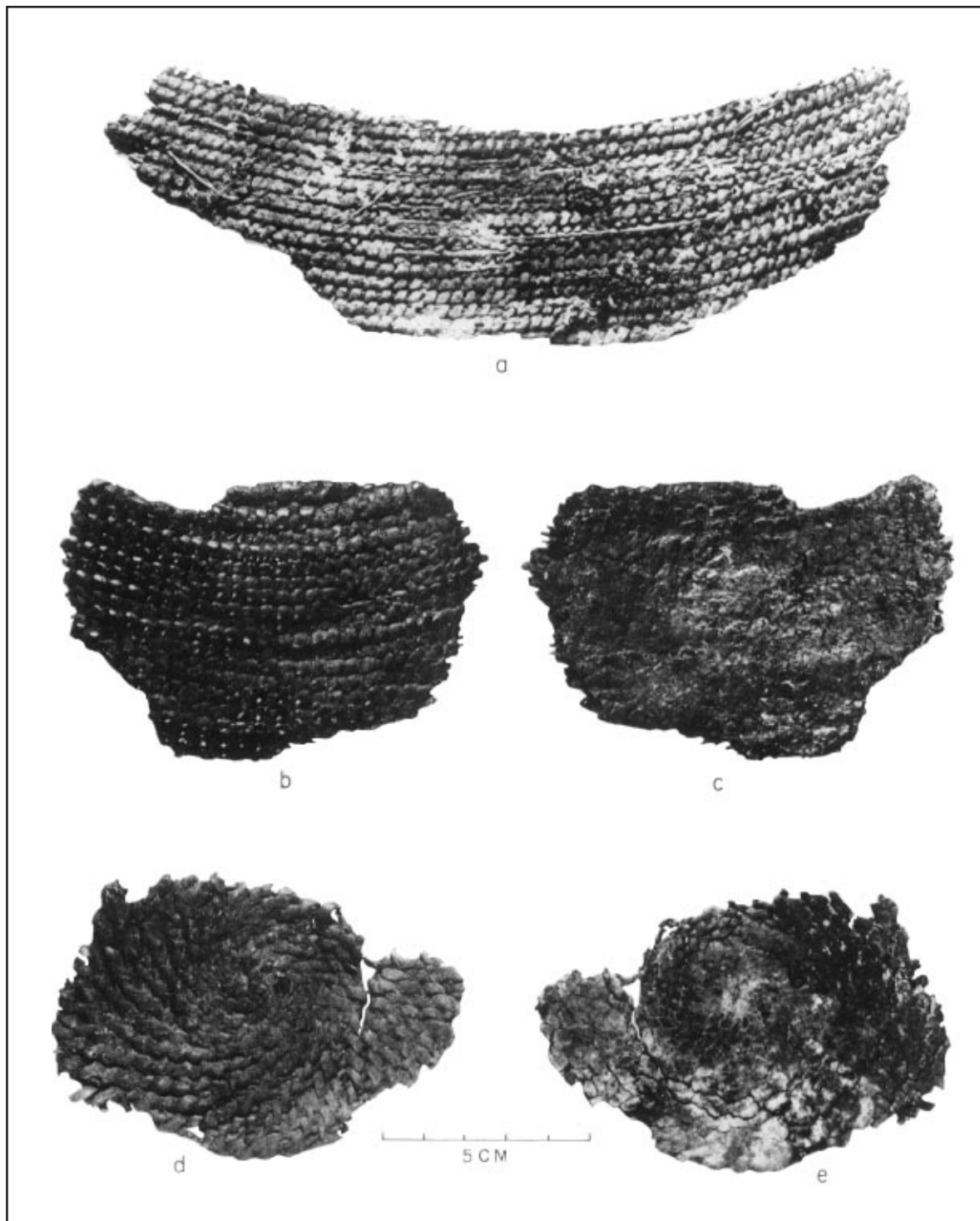


Plate 52. Coiled basketry, Layer 36: (a,b,d) exterior surfaces; (c,e) interior surfaces with coating.

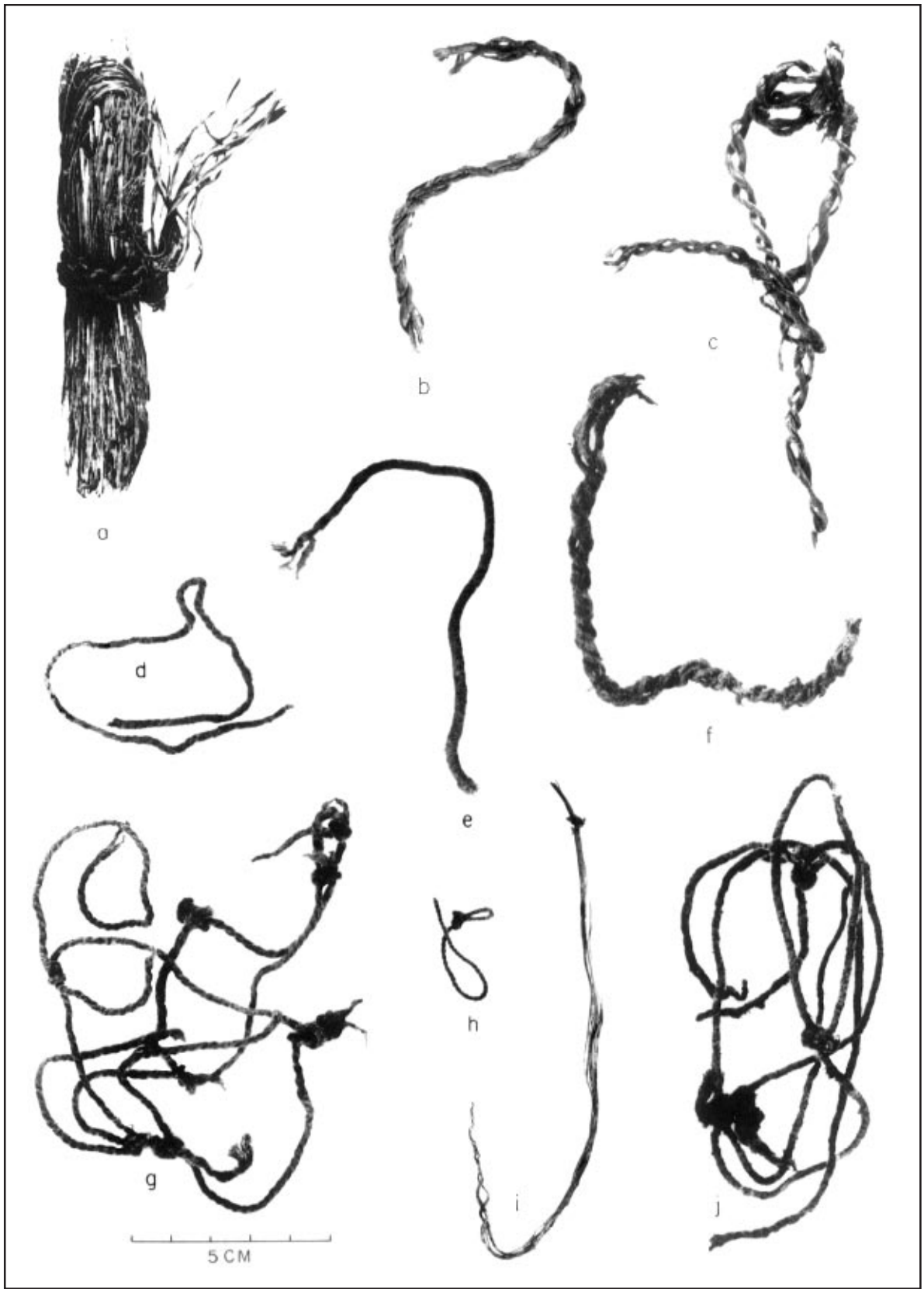


Plate 53. Brush and cordage, Layer 36: (a) grass brush; (b–h,j) plant fiber cordage; (i) sinew cordage.



Plate 54. Bark and grass, Layer 36: (a,d,e) bark bundles; (b) knotted bark strip; (c) moccasin liner.



Plate 55. Bark, Layer 36: (a) knotted strip; (b,c) bundles.



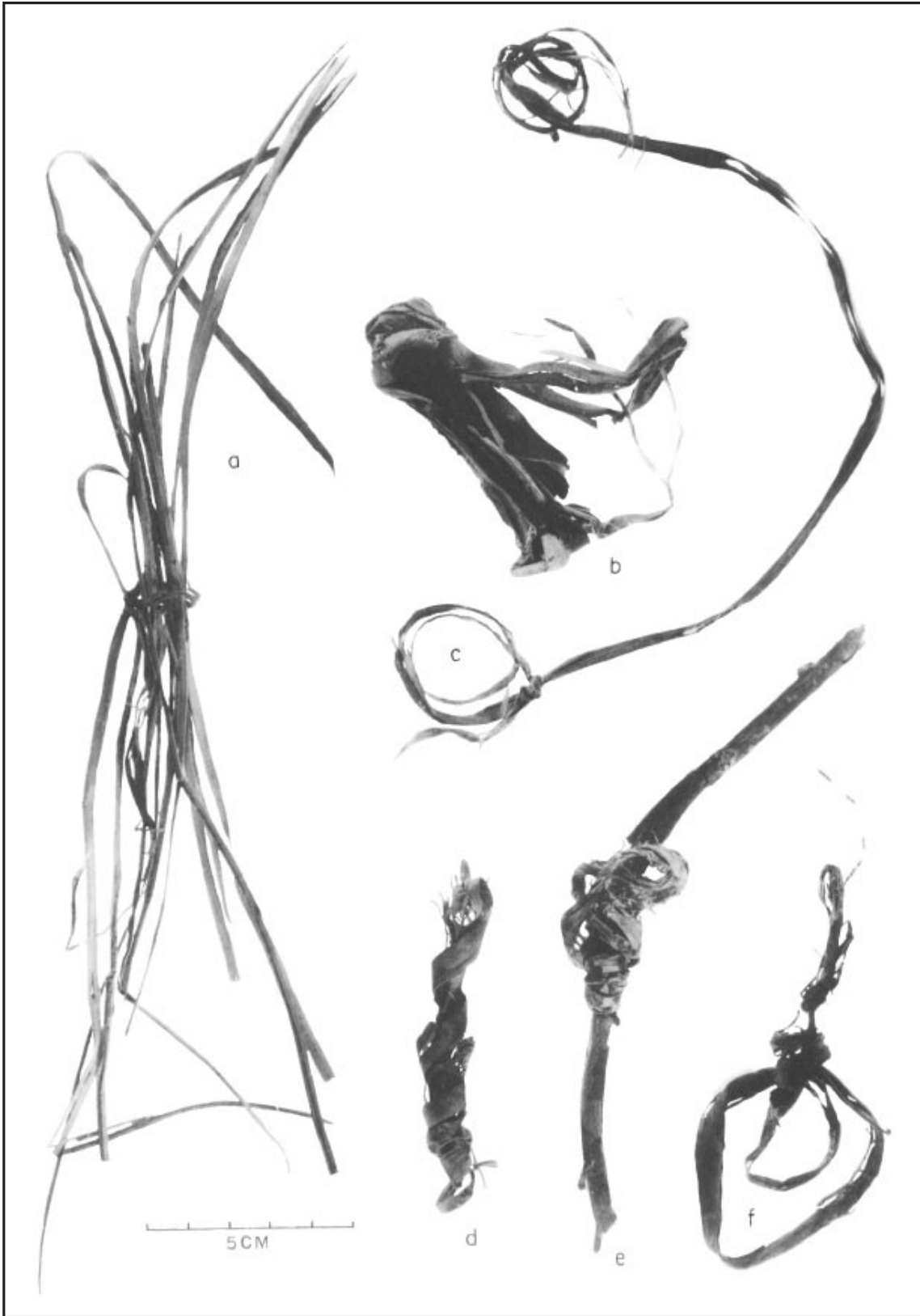


Plate 56. Wood and bark, Layer 36: (a) basketry splints; (c,f) knotted bark strips; (b,d) bark bundles; (e) bark wrapped twig.



Plate 57. Wood and hide, Layer 36: (a) U-shaped stick; (b) boot or moccasin.

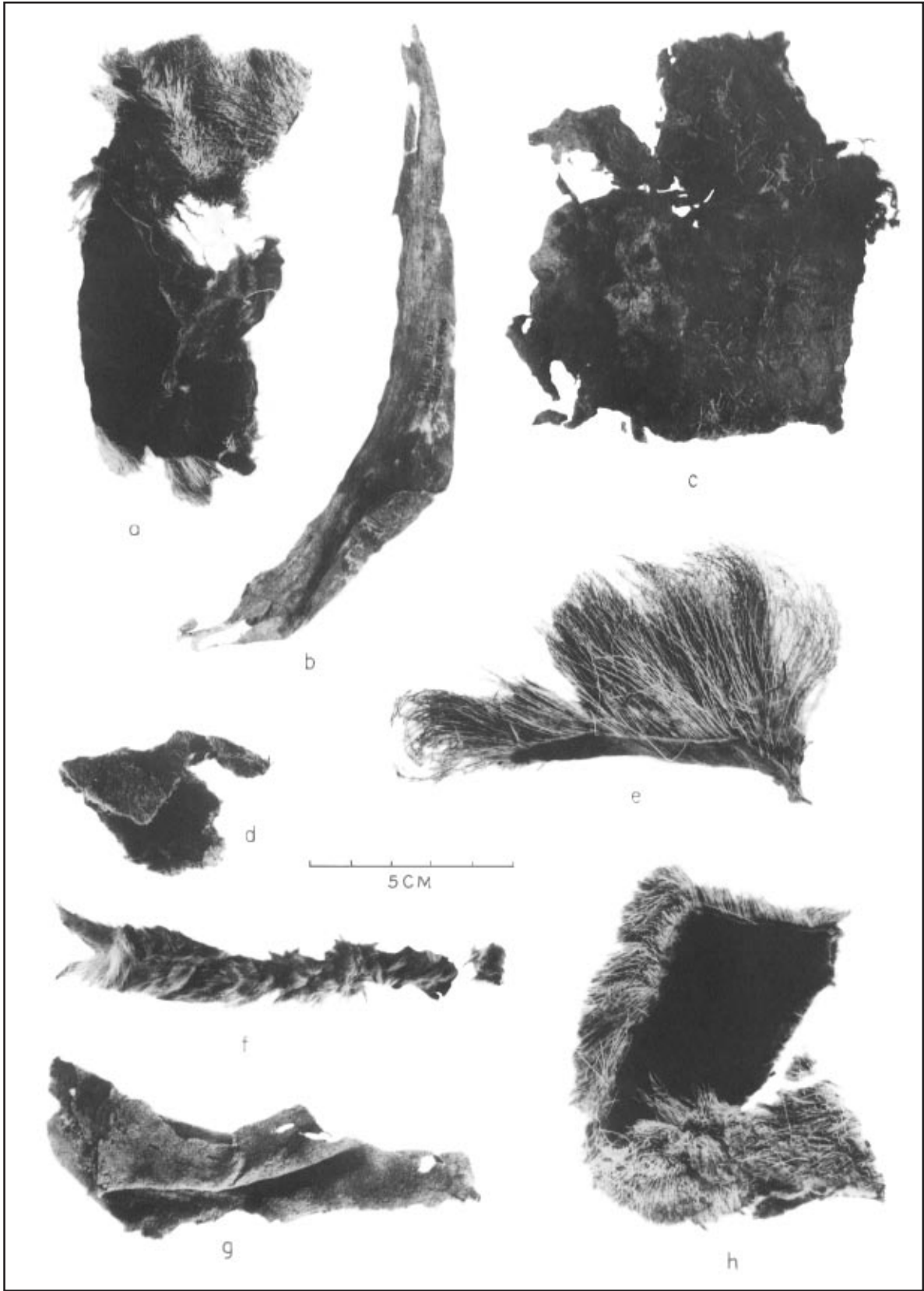


Plate 58. Hide and hair, Layer 36: (a,c) sewn hide; (b,d,g) perforated hide; (e,h) cut hide; (f) fur cloth.

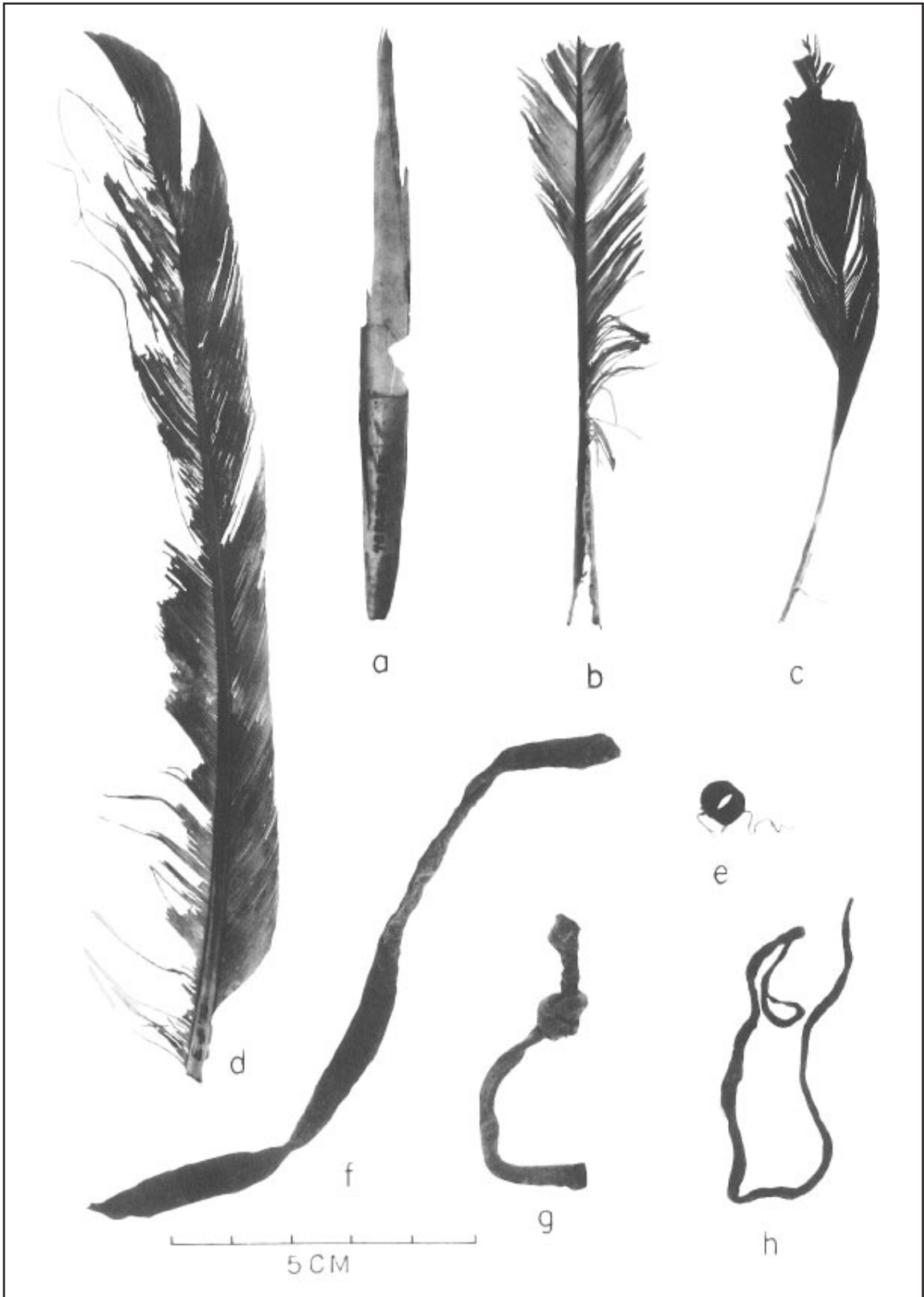


Plate 59. Feathers, hide, and sinew, Layer 36: (a) feather shaft; (b,c) trimmed feathers; (d) feather; (e) arrow binding; (f-h) thongs.

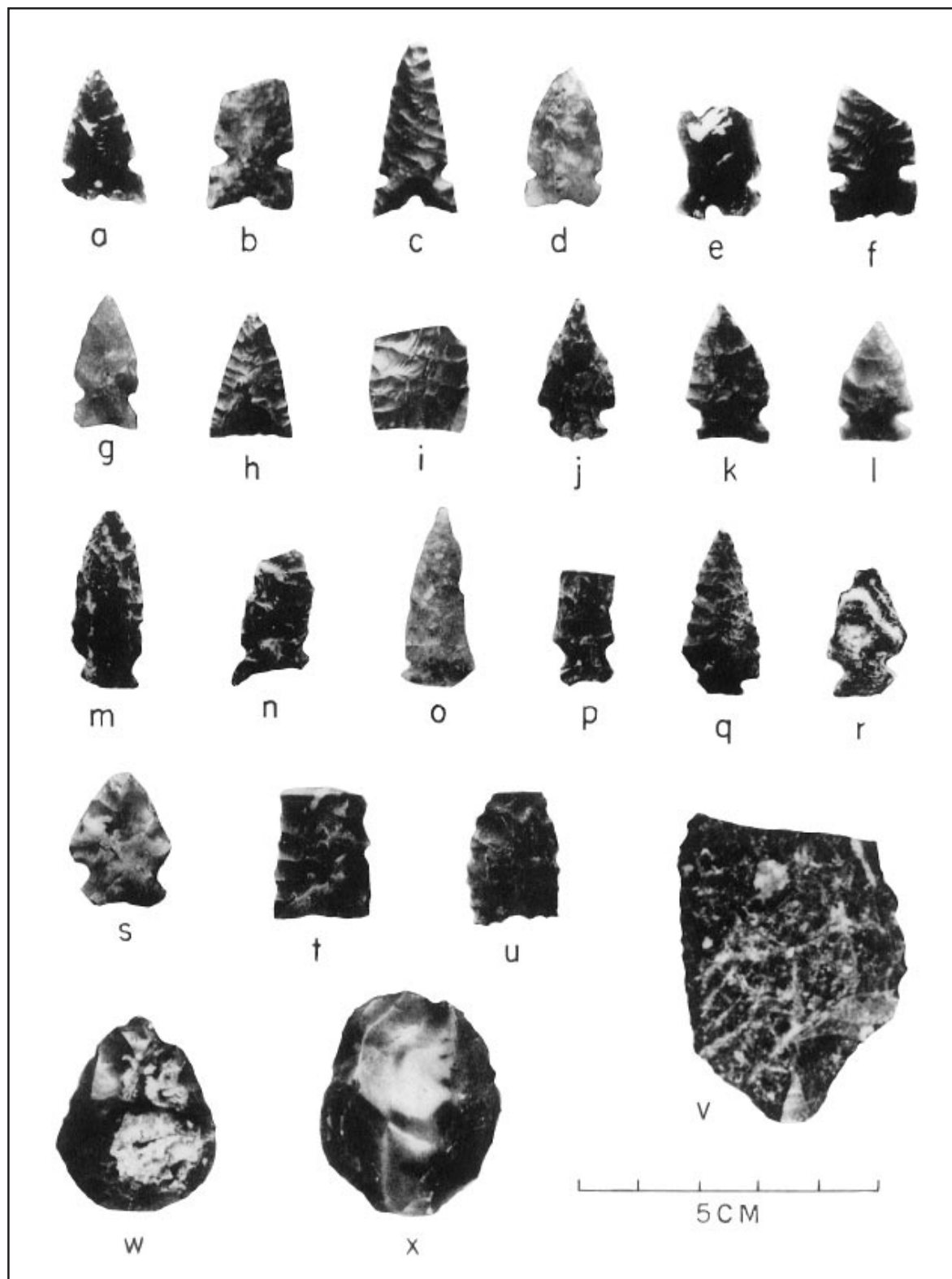


Plate 60. Chipped stone: (a–e) triangular, side- and base-notched points, Layer 38; (f,g) triangular, side-notched points, Layer 38; (h) fine triangular point, Layer 38; (i) triangular points, Layer 38; (j) side-notched, convex base point, Layer 37; (k–s) side-notched straight or concave base point, Layer 37; (t,u) triangular points, Layer 37; (v) modified flake, Layer 37; (w) trianguloid end scraper, Layer 38; (x) ovate high-angle end scraper.

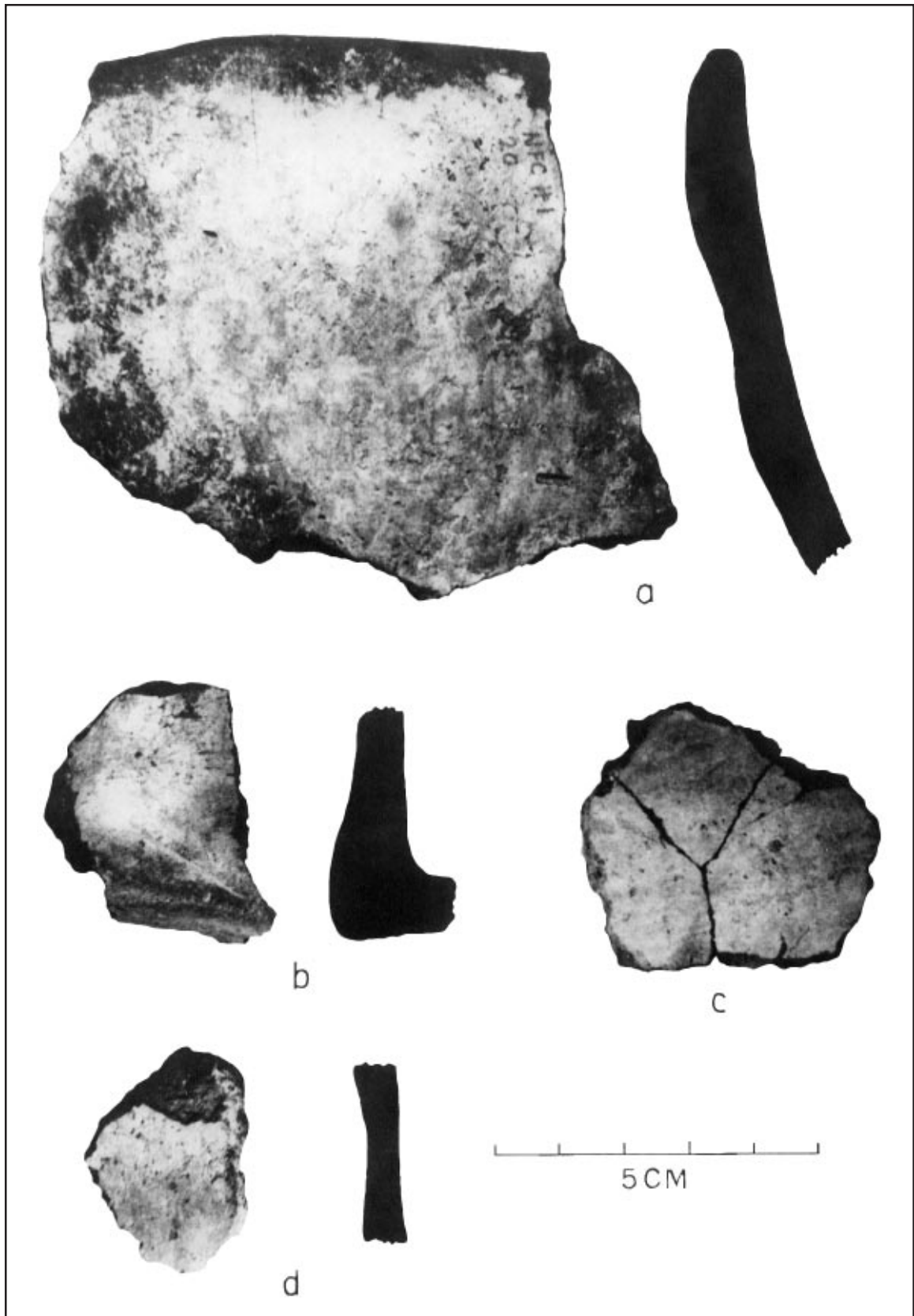


Plate 61. Pottery, Layer 38: (a) rim sherd; (b) base sherd; (c,d) body sherds.

